MOFFAT
COLLECTION SYSTEM PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

Appendix K:

Preliminary Section 404(b)(1) Guidelines Analysis

Photo provided courtesy of Denver Water.

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List of Acronyms

°C	degrees Celsius
%	percent
AF	acre-feet
AF/yr	acre-feet per year
ARNF	Arapaho & Roosevelt National Forests
AWTP	Advanced Water Treatment Plant
BA	Biological Assessment
Bi-City	Littleton-Englewood
BMP	Best Management Practice
BO	Biological Opinion
BR	Blue River
cfs	cubic feet per second
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CNHP	Colorado Natural Heritage Program
Corps	U.S. Army Corps of Engineers
CPW	Colorado Parks and Wildlife
CR	Colorado River
CWA	Clean Water Act
DEIS	Draft Environmental Impact Statement
Denver Water	Board of Water Commissioners
DO	dissolved oxygen
ECA	Environmental Conservation Area
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FR	Fraser River
FWMP	Fish and Wildlife Mitigation Plan
IRP	Integrated Resources Plan
JSA	Joint Sewer Authority
LEDPA	least environmentally damaging practicable alternative
MeHg	methylmercury

mgd	million gallons per day
MIS	Management Indicator Species
Moffat Project or Project	Moffat Collection System Project
NEPA	National Environmental Policy Act of 1969, as amended
NF	North Fork
PACSM	Platte and Colorado Simulation Model
PCA	Potential Conservation Area
PHABSIM	Physical Habitat Simulation
PRRIP	Platte River Recovery Implementation Program
RFFA	reasonably foreseeable future action
RIMBY	Right In My Backyard
ROW	right-of-way
SBC	South Boulder Creek
SH	State Highway
STORET	Storage and Retrieval EPA Database
SPWRAP	South Platte Water Related Activities Program, Inc.
SWMP	stormwater management plan
TDS	total dissolved solid
TMDL	Total Maximum Daily Load
TOC	total organic carbon
TSS	total suspended solid
U.S.	United States
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WF	Williams Fork
WQCD	Water Quality Control Division
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
ZLD	zero liquid discharge

1. INTRODUCTION

This preliminary Section 404(b)(1) compliance evaluation, prepared by the United States (U.S.) Army Corps of Engineers (Corps), documents the analysis of potential environmental consequences associated with the proposed Moffat Collection System Project (Moffat Project or Project). The Project proponent is the City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water). The mission of Denver Water is to provide high quality, dependable, and safe drinking water to about 1.3 million customers in the Denver Metropolitan area and its distributor contractors, and to provide raw water to several contractors.

Because the proposed Moffat Project would involve the discharge of dredge and fill material into wetlands or other waters of the U.S., a permit is required from the Corps under Section 404 of the Clean Water Act (CWA). Denver Water has notified the Corps that it will seek a Section 404 Permit for the Moffat Project. Based on a review of the Moffat Project, the Corps determined that the Moffat Project would likely significantly affect the quality of the human environment and, therefore, an Environmental Impact Statement (EIS) was prepared. The Corps is the lead Federal agency for compliance with the National Environmental Policy Act of 1969, as amended (NEPA) and will use the EIS, in part, in rendering a final permit decision. The EIS has been prepared in compliance with the Corps' NEPA implementation procedures for its regulatory program (Appendix B of 33 Code of Federal Regulations [CFR] Part 325), the Section 404(b)(1) Guidelines (40 CFR 230), and applicable public interest review factors identified at 33 CFR Part 320.4. A final Section 404(b)(1) analysis will be completed as part of the evaluation of a Section 404 Permit, after a Final Environmental Impact Statement (FEIS) is issued. This appendix is a preliminary evaluation of the issues involved in a 404(b)(1) analysis, but is not intended to be the final evaluation.

Projects subject to the Individual Permit process by the Corps under the CWA must comply with Section 404(b)(1) Guidelines (40 CFR 230) for discharge of dredge and fill material into waters of the U.S. Section 404(b)(1) Guidelines of the CWA require that "except as provided under Section 404(b)(2), no discharge of dredge or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences." The Section 404(b)(1) Guidelines consider an alternative practicable "if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." Practicable alternatives under the Section 404(b)(1) Guidelines assume that "alternatives that do not involve special aquatic sites are available, unless clearly demonstrated otherwise." The Section 404(b)(1) Guidelines also assume that "all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise."

2. ALTERNATIVES ANALYSIS

The alternatives screening process is described in detail in the Moffat Project EIS Alternatives Screening Report (Corps 2007). As described in Chapter 2 of the Moffat Project FEIS, the alternatives screening process for the Moffat Project was conducted in accordance with both NEPA and Section 404(b)(1) Guidelines. The identification, verification, evaluation, and screening of all alternatives were conducted by the Corps, with review and input from the following cooperating and consulting agencies: U.S. Environmental Protection Agency (EPA), Federal Energy Regulatory Commission (FERC), and Grand County.

Appendix K
Preliminary Section 404(b)(1) Guidelines Analysis

2.1 INTRODUCTION

Several alternatives were evaluated in compliance with the Section 404(b)(1) Guidelines. The Section 404(b)(1) Guidelines require that the Corps permits the least environmentally damaging practicable alternative (LEDPA). The alternatives analysis required for Section 404(b)(1) Guidelines can be conducted either as a separate analysis for Section 404 permitting or incorporated into the NEPA process. The Corps has integrated NEPA and Section 404(b)(1) Guidelines into the alternatives analysis to ensure that the alternatives selected for evaluation in the Moffat Project FEIS provide a reasonable range of alternatives and that the alternatives are practicable.

2.2 PROJECT PURPOSE

Denver Water's Collection System is composed of two major systems: the North System (also known as the Moffat Collection System) and the South System. These two raw water systems are geographically distinct and are not physically connected. The two collection systems are shown in and described in detail in Section 1.3 of the Moffat Project FEIS.

Denver Water developed an Integrated Resources Plan (IRP) in 1997, with an update in 2002, to analyze existing and future water supplies and customer demands (Denver Water 1997, 2002). Based on the IRP and events such as the 2002 drought and forest fires in publicly-owned watersheds that provide the majority of Denver Water's supply, Denver Water identified four needs in the Moffat Collection System that required resolution. These needs were presented to the public during the Moffat Project NEPA scoping in 2003, are as follows:

- **The Reliability Need** – Existing water demands served by Denver Water's Moffat Collection System exceed available supplies from the Moffat Collection System during a drought, causing a water supply reliability problem. In a severe drought, even in a single severe dry year, the Moffat Water Treatment Plant (WTP)—one of three treatment plants in Denver's system—is at a significant level of risk of running out of water.
- **The Vulnerability Need** – Denver Water's Collection System is vulnerable to man-made and natural disasters because 90 percent (%) of available reservoir storage and 80% of available water supplies rely on the unimpeded operation of Strontia Springs Reservoir and other components of Denver Water's South System.
- **The Flexibility Need** – Denver Water's treated water transmission, distribution, and water collection systems are subject to failures and outages caused by routine maintenance, pipe failures, treatment plant problems, and a host of other unpredictable occurrences that are inherent in operating and maintaining a large municipal water supply system. These stresses to Denver Water's ability to meet its customers' water supply demands require a level of flexibility within system operations that is not presently available.
- **The Firm Yield Need** – Denver Water's near-term (prior to 2032) water resource strategy and water service obligations, which have occurred since the IRP was developed, have resulted in a need for 18,000 acre-feet per year (AF/yr) of new near-term firm yield. This need was identified after first assuming successful implementation of a conservation program, construction of a non-potable recycling project, and implementation of a system refinement program.

During the NEPA scoping process, Denver Water did not select a specific project to address these needs, but rather explored various alternatives through the NEPA alternatives screening process, which led to the selection of their preferred alternative. Refer to Section 1.2 of the FEIS for further details on Denver Water's preferred alternative.

Based on comments received during NEPA scoping and guidance from the Corps, Denver Water developed a Purpose and Need statement, and prepared a document to substantiate the statement and provide background information on their water supply system. The draft document was reviewed by the Corps, EPA, FERC, and the U.S. Forest Service (USFS). The final document was published in 2004 as the Purpose and Need statement for the Moffat Project (Denver Water 2004a).

The Corps, exercising its independent judgment while considering both Denver Water's and the public's perspectives (33 CFR 325, Appendix B.9[b][4]), evaluated and accepted the Purpose and Need statement as the basis for defining and evaluating alternatives within the Corps' decision-making process (Corps 2004).

2.3 PURPOSE AND NEED STATEMENT

The purpose of the Moffat Collection System Project is to develop 18,000 acre-feet per year of new, firm yield to the Moffat Treatment Plant and raw water customers upstream of the Moffat Treatment Plant pursuant to the Board of Water Commissioners' commitment to its customers.

Denver Water's need for the proposed Moffat Project is based on two major issues, one of timeliness and one of location:

- **Timeliness: Water Supply Shortage in the Near-Term Timeframe (Prior to 2032)**—Beginning in 2022, Denver Water predicts its average annual water demand will exceed available supplies and will grow to 34,000 AF/yr by 2032. This shortfall was determined after analyzing existing supply, projected demand, and savings from system refinements, non-potable reuse, natural replacement, and cooperative projects with other water providers. Of this near-term 34,000 AF/yr shortfall, Denver Water will rely on 16,000 AF/yr forthcoming from the implementation of additional conservation efforts. New firm yield must be identified to meet the remaining shortfall. Denver Water proposes to meet the remaining shortfall with 18,000 AF/yr of newly developed supplies.
- **Location: Need for Water to the Moffat Water Treatment Plant**—Approximately 90% of the available reservoir storage and 80% of the available water supplies rely on the South System. This imbalance in reservoir storage and water supplies between the North and South systems has created water supply challenges that have resulted in:
  - Unreliable water supply for the Moffat WTP and Moffat Collection System raw water customers
  - System-wide vulnerability issues
  - Limited operational flexibility of the treated water system

Section 1.4.4 of the FEIS provides further discussion on the availability of water to the Moffat WTP, and system-wide vulnerability and flexibility issues.

To address the two major issues, Denver Water is pursuing the proposed Moffat Project to provide 18,000 AF/yr of new firm yield to the Moffat WTP. The proposed Project would address both the overall near-term water supply shortage, and the existing imbalance in water storage and supply between the North and South systems.

2.4 ALTERNATIVES SCREENING

To satisfy Section 404(b)(1) and NEPA requirements, the Corps' alternatives screening process included two levels of screening – Screen 1 and Screen 2.

- Screen 1 progressed from a wide spectrum of potential water supplies and infrastructure components to a well-defined set of Project alternatives using numerous evaluation criteria related to Purpose and Need, existing technology, logistics, costs, and environmental consequences.
  - **Screen 1a** – A broad range of 303 potential water supply sources and infrastructure components were identified, which could be part of a Project alternative to supply water to the Moffat WTP. A set of exclusionary criteria were used to eliminate those sources or components not capable of meeting the basic Project Purpose and Need, or that had fatal flaws. A total of 261 sources or components were screened out, leaving 42 to be carried forward to Screen 1b, including 29 storage components.
  - **Screen 1b** – The remaining 42 water supply sources and infrastructure components were used to formulate possible Project alternatives by matching a potential water source with water storage and conveyance components that would meet the Project Purpose and Need. A preliminary environmental screen was conducted on the remaining 29 potential storage sites to help configure possible alternatives with the least environmental damage. A total of 21 storage sites were eliminated, leaving eight sites, plus deep aquifer storage and gravel pit storage. The storage components and water sources were combined to formulate 34 alternatives carried forward to Screen 1c.
  - **Screen 1c** – The 34 Project alternatives were next screened on the basis of relative major capital costs. The rough order-of-magnitude estimates were converted to a relative cost index based on the least cost alternative. Those alternatives not considered practicable from a cost perspective were eliminated. The remaining 14 alternatives were carried forward for further evaluation in Screen 2.
- Screen 2 involved a more in-depth analysis of the Project alternatives using criteria focused on environmental impacts to the aquatic environment and other natural ecosystems. The results of Screen 2 were a set of five alternatives carried forward for further analysis in the FEIS:
  - **Alternative 1a (Proposed Action):** 72,000 acre-feet (AF) enlargement of Gross Reservoir
  - **Alternative 1c:** 40,700 AF enlargement of Gross Reservoir combined with a new 31,300 AF reservoir at Leyden Gulch
  - **Alternative 8a:** 52,000 AF enlargement of Gross Reservoir combined with reusable return flows and gravel pit storage (5,000 AF)
  - **Alternative 10a:** 52,000 AF enlargement of Gross Reservoir combined with 20,000 AF of Denver Basin aquifer storage
  - **Alternative 13a:** 60,000 AF enlargement of Gross Reservoir combined with transfer of agricultural water rights and gravel pit storage (3,625 AF)

The five alternatives carried forward for FEIS analysis represent a reasonable cross-section of practicable alternatives, which encompass a broad range of potential water supplies and storage sites. These alternatives all utilize Denver Water's supplies from the Fraser River, Williams Fork River, and South Boulder Creek to varying degrees. Alternatives 8a, 10a, and 13a utilize Denver Water's reusable water or transferred agricultural water rights to reduce the portion of supply

derived from additional trans-mountain diversions. The five alternatives include various combinations and sizes of a Gross Reservoir enlargement and a new Leyden Gulch Reservoir. In addition, Alternatives 8a and 10a partially rely on shallow and deep aquifer storage to some degree instead of just surface storage.

2.5 OVERVIEW OF PROJECT ALTERNATIVES

The Corps analyzed a total of five action alternatives in addition to the No Action Alternative. Table 1 presents a summary of the five Moffat Project FEIS action alternatives and this section more fully explains each alternative.

Table 1
List of the Moffat Project FEIS Action Alternatives

Alternative Name		Description
1	**Moffat Collection System** **Predominantly wet year Fraser River, Williams Fork River, and South Boulder Creek water would be the water source using the existing Moffat Collection System infrastructure.**	
a	Gross Reservoir Expansion	Storage is provided in an **enlarged Gross Reservoir (72,000 AF additional); 77,000 AF with the Environmental Pool.***
c	Gross Reservoir Expansion and New Leyden Gulch Reservoir	Storage is provided in an **enlarged Gross Reservoir (40,700 AF additional)** and a **new Leyden Gulch Reservoir (31,300 AF).**
8	**Gravel Pit Storage/Moffat Collection System**	
a	Gravel Pit Storage and Gross Reservoir Expansion	Unused reusable water in the South Platte River is diverted to a series of new gravel pit storage facilities near Brighton, Colorado. Water is recovered from the gravel pit storage, treated at a **new Advanced Water Treatment Plant (AWTP)**, and then conveyed to the Moffat Collection System delivery point via Conduit O. Storage is provided in **gravel pits** along the South Platte River (**approximately 5,000 AF**). Using existing collection infrastructure, water from the Fraser River, Williams Fork River, and South Boulder Creek is diverted and delivered during average to wet years via the Moffat Tunnel and South Boulder Creek, and stored in an **enlarged Gross Reservoir (52,000 AF additional).**
10	**Deep Aquifer Storage Project/Moffat Collection System**	
a	Deep Aquifer Storage and Gross Reservoir Expansion	Unused reusable water in the South Platte River is diverted to the Denver Water Recycling Plant, treated and transferred to a new advanced water treatment facility. The advanced water treatment water is pumped to injection wells to recharge the **Denver Basin aquifer (20,000 AF)** located within the City and County of Denver. Recovered water is collected from the wells, manifolded into new conveyance pipes, and pumped to the Moffat Collection System delivery point via Conduit M. Using existing collection infrastructure, water from the Fraser River, Williams Fork River, and South Boulder Creek is diverted and delivered during average to wet years via the Moffat Tunnel and South Boulder Creek, and stored in an **enlarged Gross Reservoir (52,000 AF additional).**

Table 1
List of FEIS Action Alternatives (continued)

	Alternative Name	Description
13	**Agricultural Water Conversion/Moffat Collection System**	
a	Agricultural Water Rights Purchase, Gravel Pit Storage, and Gross Reservoir Expansion	Agricultural water rights, located downstream of the Metro Wastewater Reclamation District Plant (Metro WWTP), are purchased and converted to municipal/industrial use to generate **3,000 AF/yr of new firm yield**. A new diversion on the South Platte River diverts water to a series of **gravel pit storage facilities (approximately 3,625 AF of storage)** near Brighton, Colorado. Water is recovered from the gravel pit storage, treated at a new AWTP, and then conveyed via Conduit O to the Moffat Collection System delivery point near SH 72. Using existing collection infrastructure, water from the Fraser River, Williams Fork River, and South Boulder Creek is diverted and delivered during average to wet years via the Moffat Tunnel and South Boulder Creek, and stored in an **enlarged Gross Reservoir (60,000 AF additional).**

Notes:
*Section 2.5.5 of this document and Section 2.3.2.1 of the Final Environmental Impact Statement describe the Environmental Pool for mitigation.
Individual surface storage reservoir sizes are for purposes of evaluating a practical range of Project alternatives and do not represent the final planned size. Further alternative development and refinement in subsequent Project phases will be required.
AF = acre-feet
AF/yr = acre-feet per year
AWTP = Advanced Water Treatment Plant
M&I = municipal and industrial
SH = State Highway
WWTP = Wastewater Treatment Plant

2.5.1 Potential Water Sources

Three potential sources for increased water supply were considered for the action alternatives: (1) additional Moffat Collection System supplies (West and East Slope water), (2) reusable return flows on the South Platte River, and (3) South Platte River water rights transfers.

1. Additional Moffat Collection System Supplies

All of the action alternatives would use water supplies derived from the Moffat Collection System (North System). (Refer to Section 1.3.1 of the Moffat Project FEIS for more details on Denver Water's raw water collection system.) Additional water is available for diversion under existing Denver Water water rights from the Fraser River, Williams Fork River, and South Boulder Creek.

Each of the action alternatives would provide additional storage in the Moffat Collection System. Denver Water would divert additional water from the Fraser River, Williams Fork River, and South Boulder Creek basins in average and wet years. Additional diversions would be greatest in wet years, including wet years following dry year sequences. Without additional storage, Denver Water's diversions are physically constrained in average and wet years from these basins because of limitations of available storage capacity. Denver Water's diversions are legally constrained because of water rights and existing agreements. In dry years, Denver Water's diversions from the Moffat Collection System are not limited to the amount of water available at its diversion points; the physical constraint is not because of available storage capacity on the East Slope. Additional supplies would be used to meet an overall higher level of demand and would be critical during dry periods or to accommodate system disruptions.

Existing diversion and conveyance facilities, including the Moffat Tunnel and South Boulder Diversion Canal, have adequate capacity to divert and convey the additional flow to the potentially enlarged and/or new storage facilities.

2. Reusable Water

All water delivered by Denver Water to its customers is classified under Colorado Water Law as reusable or non-reusable. Reusable water can be used and reused to extinction, whereas non-reusable water is used and legally accounted for only once. Denver Water keeps track of reusable return flows and currently uses, or is planning to use, most of its reusable supplies through river exchanges, transfers to gravel pits, and to supply water for the non-potable recycling project. However, some return flows will remain available for other uses. Approximately 7,600 AF of unused return flows will be available primarily in the winter months, when Denver Water's customer demands, non-potable demands, and exchange potential are relatively low. New storage and conveyance facilities would be needed to make this reusable supply source available when needed by Denver Water. The reusable flows could be combined with other water sources to meet the entire needed 18,000 AF/yr of new firm yield.

Alternative 8a would use unused reusable return flows diverted from the South Platte River as a water source. Alternative 10a would use unused reusable return flows (effluent) from the Denver Water Recycling Plant as a water source. For these alternatives, 13,000 AF/yr of firm yield comes from additional storage in Gross Reservoir, which in turn comes from additional diversions from the Williams Fork and Fraser river basins, and South Boulder Creek. An additional 5,000 AF/yr of firm yield comes from reusable water supplies. The reusable supplies are only used during drought conditions; therefore, these supplies would be used infrequently and only when needed to supplement Moffat Collection System supplies. The reusable supplies would be used to supplement Denver Water's South Platte River, the Blue River, and Moffat Collection System supplies primarily because of the additional costs associated with treatment and conveyance and potential water quality issues associated with blending that water with Moffat Collection System water.

3. South Platte River Water Transfers

Agricultural water rights owned by ditch companies would be purchased, converted to municipal/industrial use and diverted from the South Platte River upstream of Brighton. The firm yield available from this source would depend on the specific rights to be acquired, and new storage and conveyance facilities would be needed to make this reusable supply source available to Denver Water. Alternative 13a would use approximately 3,000 AF/yr of new South Platte River water transfers as a water source combined with additional Moffat Collection System supplies to meet the needed 18,000 AF/yr of new firm yield.

2.5.2 Potential Storage Components

Four potential storage components are considered for the action alternatives: (1) Gross Reservoir (existing), (2) Leyden Gulch Reservoir (proposed), (3) gravel pit storage along the South Platte River, and (4) the Denver Basin aquifers.

1. Gross Reservoir

Four expansion scenarios were considered for Denver Water's existing Gross Reservoir: 72,000 AF (77,000 AF with the Environmental Pool for mitigation), 60,000 AF, 52,000 AF, and 40,700 AF of additional storage capacity.

2. Leyden Gulch Reservoir

A new 31,300 AF reservoir would be constructed in Jefferson County.

3. Gravel Pit Storage

A series of gravel pits along the South Platte River would be developed into storage facilities. Two storage scenarios were considered: approximately 5,000 AF and 3,625 AF.

4. Denver Basin Aquifers

An injection/recovery wellfield would be developed within the City and County of Denver to provide approximately 20,000 AF of storage in the Denver Basin deep aquifers. Water would be injected into and recovered from the upper Arapahoe, lower Arapahoe, and Laramie-Fox Hills aquifers of the Denver Basin as needed.

2.5.3 Advanced Water Treatment Technologies

The original Moffat WTP, built in 1937 with a capacity of 50 million gallons per day (mgd), has since undergone two expansions and improvements to operate at a current capacity of 185 mgd (MWH 2007). Summer production (from May to September) is 100 mgd or more, and winter production averages approximately 30 mgd. Raw water is delivered to the Moffat WTP from Ralston Reservoir, which is filled with water from the Moffat Collection System via the South Boulder Diversion Canal. The raw water is considered high quality and the Moffat WTP was designed to treat this level of water quality.

The proposed water sources for Alternatives 8a, 10a, and 13a would be unused reusable water or agricultural water from the South Platte River, in addition to Moffat Collection System water. Water quality of the South Platte River below Denver is considerably different than the Moffat Collection System raw water. Potential South Platte River water quality problems include elevated levels of total dissolved solids (TDSs), hardness, bacteria, nutrients, and emerging contaminants of concern, which can include personal care and pharmaceutical products and endocrine disrupting compounds. The Moffat WTP is not capable of removing high or problematic concentrations of these constituents found in the source water associated with Alternatives 8a, 10a, and 13a. The Moffat WTP would have potential problems complying with regulatory drinking water requirements for the finished water quality under these alternatives. Consequently, an Advanced Water Treatment Plant (AWTP) would be needed as a component of these alternatives.

Two technologies were considered for the advanced water treatment requirements of Alternatives 8a, 10a, and 13a:

1. **Membrane treatment with zero liquid discharge (ZLD) for concentrate disposal** – The membrane treatment process includes the following primary processes: sedimentation, low-pressure membrane pre-treatment, reverse osmosis, advanced oxidation (process with ultraviolet and hydrogen peroxide), disinfection, and followed by ZLD components for residual disposal. (Refer to the discussion below under Membrane Advanced Water Treatment Facility for further details.)
2. **Nonmembrane treatment with solids drying bed waste disposal** – The non-membrane treatment process includes bank filtration, softening, filtration, advanced oxidation with ultraviolet and hydrogen peroxide, and disinfection. Residuals would be concentrated using solids drying beds. This treatment would be similar to the concept planned by the City of Aurora for its Prairie Waters Project, but modified to address different source water characteristics and water uses for the Moffat Collection System.

Both types of plants would be configured to remove or reduce target adverse water quality constituents by treatment process or by blending water from the South Boulder Diversion Canal.

These two technological approaches bring advantages and disadvantages related to their integration in the Moffat Collection System. The membrane system offers reliable treatment of the targeted contaminants and reduces TDS effectively, but preservation of the membranes may be an issue for prolonged plant shutdowns. ZLD has not been widely used in the municipal water sector and its operation is complex and expensive. The non-membrane technology provides relatively reliable treatment of the targeted contaminants, except for TDS (which would require blending to meet EPA secondary TDS limits), but also requires a large footprint (plant and other associated facilities including bank filtration). This type of plant is also difficult to start up after shutdowns due to the biological processes that are involved. Figures C-1 through C-4 in Appendix C of the Moffat Project FEIS present the process schematics for both the membrane and non-membrane systems.

Based on an EIS-level independent review of the treatment technologies, the membrane system was selected for analysis in tandem with Alternatives 8a, 10a, and 13a, since the membrane advanced water treatment technology would produce higher water quality for the Moffat WTP, with fewer risks and reliability concerns, and would require considerably less land for the facility (approximately 80 acres versus 200 acres) (Boyle 2008).

Membrane Advanced Water Treatment Facility – A preliminary site plan for the membrane system is shown on Figure C-5 in Appendix C of the Moffat FEIS (Boyle 2008). Raw water from the South Platte River would be treated at the AWTP and delivered to the Moffat Collection System delivery point. The waste stream from the advanced water treatment process would be disposed of through the ZLD process, in which all water is removed from the brine and the solids properly disposed of. The water is removed using solar evaporation ponds and solids drying beds, and the dried solids disposed of through a private disposal company or at a monofill (a specialized landfill with segregated cells for only these materials).

2.5.4 No Action Alternative

The No Action Alternative assumes that Denver Water would not receive approval from the Corps to implement the Moffat Project. The No Action Alternative would require Denver Water to use a combination of strategies to meet the need for additional water supply, including using a portion of its Strategic Water Reserve and imposing mandatory restrictions to help reduce demand during drought periods. However, these strategies would not resolve the system vulnerabilities, flexibility, or reliability problems identified in the Purpose and Need.

In the event that a Section 404 Permit is not issued, Denver Water would continue to develop and implement its conservation, non-potable recycling, system refinements, and cooperative action projects as described in the 2002 IRP (Denver Water 2002). Refer to Section 1.4 of the Moffat Project FEIS for details of this plan. Assuming these projects and activities are fully implemented, demand on the Denver Water system is still projected to exceed supply in the near future (currently estimated around 2022), as shown on Figure 1-5 in Chapter 1, Purpose and Need, of the Moffat Project FEIS. If additional supplies are not developed, Denver Water's average demand would exceed its supply by 15,000 AF/yr in 2032 (does not include 3,000 AF per year for Arvada).

Consistent with the action alternatives, the No Action Alternative is based on the following assumptions and conditions (Section 2.10.1 of the Moffat Project FEIS):

- Hydrologic modeling of the No Action Alternative is based on the same future water demands as the action alternatives (363,000 AF/yr by the year 2032). The demand includes the 3,000 AF of firm yield for the City of Arvada.

- All water system improvements designed to provide additional sources of water supply through approximately 2022 currently planned and under development are accomplished. Examples include the non-potable recycling project and downstream gravel pit storage.
- Demand projections assume 100% success in implementing Denver Water's conservation goals identified in the 2002 IRP.
- There is no Colorado River Compact Call.
- The treated and raw water systems would always operate error-free.
- The No Action Alternative has the same interpretation of water rights, agreements, and permit requirements as the action alternatives.
- Hydrologic modeling of the No Action Alternative is based on the same water supply study period (1947 to 1991) as the action alternatives. The modeling does not include the severe droughts evidenced by tree-ring-based hydrology studies, nor does it include potential adverse changes due to climate change.

As compared to past droughts when Denver Water's estimated water supply exceeded demand, under the No Action Alternative there is no water supply surplus. During the recent 2002 to 2005 drought period, Denver Water's average annual water supply was 315,000 AF, and the average unrestricted customer demand was 285,000 AF/yr. Denver Water's estimated average annual surplus was 30,000 AF (315,000 AF minus 285,000 AF). However, droughts occur with unpredictable intensity and duration. During drought events, it is unknown how long the drought will last or how severe it will be, and drought periods more severe than the 1947 to 1991 study period can be expected. Even though Denver Water had an estimated surplus during the recent drought, it enacted mandatory restrictions on its customers' use of water. Under the No Action Alternative, Denver Water's average annual demand is 75,000 AF greater than the demand during the recent drought (360,000 AF minus 285,000 AF). The 360,000 AF/yr of demand does not include Arvada's additional demand of 3,000 AF/yr. This represents a 26% increase in demand; however, supplies are only estimated to increase by 30,000 AF/yr on average by 2022. The demand under the No Action Alternative would be even higher except that conservation is expected to produce an additional 16,000 AF/yr of annual savings. The 16,000 AF/yr of conservation savings is expected every year and is not available as an additional savings due to drought restrictions. This "demand hardening" will make it more difficult for customers to save water during restrictions. With 75,000 AF/yr of additional demand and the expected demand hardening, the No Action Alternative would require more frequent and severe restrictions. The No Action Alternative would have no direct or clearly discernible costs to Denver Water since facility construction or purchases are not contemplated. In attempting to meet future demands with existing facilities, it is possible that additional operation costs for pumping or treatment might occur, but such costs would be episodic and unpredictable.

By depleting the Strategic Water Reserve and instituting water restrictions with greater frequency and severity, Denver Water and its customers would experience a host of indirect costs. These costs are addressed in Section 5.19 of the Moffat Project FEIS.

No Action Alternative Components

Only those potential strategies that did not require a Corps permit were considered as possible components of the No Action Alternative. Numerous non-structural or institutional water management concepts were considered in the preliminary alternatives screening process, including buying back contract commitments, integrating operations with other water supply providers, expanding reuse, etc. (refer to Appendix B of the Moffat Project FEIS for the list of concepts

considered). These non-structural concepts were evaluated and eliminated from further consideration for the No Action Alternative because they did not meet the Purpose and Need. In addition, certain components of Alternatives 8a, 10a, and 13a, such as agricultural transfers and reusable supplies, were considered in formulating the No Action Alternative. However, the implementation of these elements with respect to storage and conveyance would likely require a Corps' permit. Because all these non-structural and other components either did not meet the Purpose and Need or would require a Corps' permit, Denver Water identified two alternative potential No Action Alternative strategies that could only address the water supply portion of the Purpose and Need. However, these strategies would not resolve the system vulnerabilities, flexibility, or reliability problems identified in the Purpose and Need.

Denver Water's existing water rights and facilities can meet an average unrestricted demand up to 345,000 AF/yr, while maintaining the 30,000 AF/yr of yield in the Strategic Water Reserve. It is currently estimated that beginning in or near 2022, in the absence of a Moffat Project and as more customers are added to the limited water supply, Denver Water would have to implement some combination of the following two strategies to manage supply and demand within the combined service area:

1. Deplete the Strategic Water Reserve, and/or
2. Rely on more frequent and severe Mandatory Water Use Restrictions.

It is impossible to accurately predict when or to what degree Denver Water would balance depletion of the Strategic Water Reserve and imposition of more frequent and severe mandatory restrictions. The balance would depend on numerous factors including storage conditions in Denver Water's North and South collection systems and hydrologic conditions. For example, Denver Water's strategy in response to a drought would depend on whether they are in the beginning or advanced stages of a drought. Each of these strategies is discussed individually below and then in combination.

Analysis of using the Strategic Water Reserve was accomplished quantitatively using the Platte and Colorado Simulation Model (PACSM). In contrast, analysis of using mandatory restrictions was accomplished qualitatively.

Strategic Water Reserve Strategy

Under the No Action Alternative, it is assumed that the additional 18,000 AF/yr of new water supply needed to meet the anticipated demands would not be developed. Instead, the Strategic Water Reserve would be reduced to help meet the need for up to an additional 15,000 AF/yr of water supply for Denver Water customers. Because of the imbalance between the North and South raw water collection systems and because there is no Strategic Water Reserve in the North System, there would still be shortages in the North System. This would result in periodic raw and treated water shortages to Denver Water customers.

The Strategic Water Reserve of 30,000 AF/yr of firm yield is maintained within Denver Water's existing system. Based on a storage-to-firm yield ratio of approximately 4:1, the Strategic Water Reserve equates to approximately 120,000 AF of water stored in Denver Water's reservoirs. The amount of Strategic Water Reserve in each reservoir varies depending on hydrologic conditions and the severity of a drought. The Strategic Water Reserve is located entirely in Denver Water's South System reservoirs, due to the imbalance in storage and raw water supplies between their North and South systems.

The No Action Alternative would require using part of the Strategic Water Reserve during drought periods. Over the 45-year study period, the Strategic Water Reserve would be drawn down in

4 years due to lack of water supply to meet customer demand (1955, 1956, 1957, and 1965). During the 1950s drought, approximately half of the 30,000 AF reserve would be used. This result assumes that: (1) the raw and treated water systems have operated error-free during the entire study period, which is unlikely; (2) the Strategic Water Reserve has not already been needed to meet man-made and natural uncertainties and emergencies; and (3) future droughts would not be more severe than those experienced during the 1947 to 1991 study period.

The Strategic Water Reserve is only available in the South System, with none available in the North System (Moffat Collection System). Due to the lack of storage in the North System, none of the Strategic Water Reserve would be available for use in Gross or Ralston reservoirs under the No Action Alternative, in which case the Moffat Collection System would run out of water in droughts. For example, model results show that the Strategic Water Reserve would not have been exhausted in 1955; however, these reserves would all be in storage in the south end of the system. Gross Reservoir and Ralston Reservoir would be down to their minimum operating storage creating a condition where a shortage to customers may occur. Raw water shortage would occur because Gross and Ralston reservoirs would be out of water. Additionally, treated water shortages may occur because Foothills and Marston WTPs would be operating at capacity, but the Moffat WTP, which is needed to help meet demand, would not have any water to treat. If one of the two remaining WTPs has an operation problem, Denver Water would not be able to meet customer water needs throughout its Combined Service Area from one WTP. During the summer, all three WTPs are required to meet customer demand. Because the Moffat Collection System runs out of water in droughts, the Moffat WTP and the Moffat Collection System raw water customers would experience water shortages. The No Action Alternative would result in the inability to meet customer demands for treated and raw water deliveries in 3 years of the 45-year study period. The total treated water and raw water shortages would have been approximately 10,000 AF during the mid-1950s drought period. The 10,000 AF of shortage during the critical period equates to approximately 2,600 AF of firm yield. According to the 1947–1991 study period, total raw water shortages of about 11,000 AF would have occurred in 1955, 1957, and 1978. Treated water shortages totaling 1,395 AF would have occurred in 1955, 1971, 1973, and 1974. The treated water shortages that occur in 1971, 1973, and 1974 are due to high demands, which exceed the combined treatment capacity of Denver Water's three WTPs. These shortages occur in only 10 days during those three years. Shortages in 1971, 1973, and 1974 would have been peak day shortages due to constraints at the treatment plants as opposed to lack of supply. Treated water shortages that occur in these years also occur under the action alternatives.

Mandatory Restrictions Strategy

The second of the two potential strategies for Denver Water to impose would be to impose more frequent and severe mandatory water use restrictions on its customers sufficient to reduce water demands to equal available supplies during the critical drought periods while maintaining the Strategic Water Reserve. Presumably, this strategy would be formulated under Denver Water's operating rules as promulgated January 1, 2008.

Denver Water has adopted a Drought Response Plan that provides a framework for addressing droughts. Three levels of drought severity have been defined, based on the predicted percentage of storage in Denver Water's reservoirs at the end of the run-off season on July 1. The basic response to a Stage 1 drought is voluntary measures; to a Stage 2 drought, mandatory restrictions; and to a Stage 3 drought, prohibitions on lawn watering. To adopt a particular drought response, the Board of Water Commissioners declares a drought level and adopts an effective date for applicable restrictions. Because Stage 2 and Stage 3 drought restrictions are mandatory, they are incorporated into the Operating Rules where they become enforceable upon a drought declaration pursuant to the

Denver Charter, the Denver Revised Municipal Code, and provisions in Denver Water's water service agreements and water leases.

In addition to the three stages described above, Denver Water also has a Stage 4 response. Each of these drought stages is triggered by the expected or actual reservoir storage levels on July 1 in any given year (Denver Water 2004b). July 1 is used as the trigger date because storage in Denver Water's reservoirs usually reaches its annual maximum around this time.

Based on Denver Water's 2002 through 2005 drought operations, mandatory restrictions may represent a strategy that Denver Water might adopt to meet its water supply needs if it does not obtain a Section 404 Permit for the Moffat Project. Since droughts are natural events that occur with unpredictable frequency and variable intensity and duration, it is unknown how long the drought would last or how severe it would be. Given these facts, it is reasonable to assume that Denver Water would impose mandatory restrictions to preserve its ability to provide essential water supplies in the face of these uncertainties. The mandatory restrictions used by Denver Water in the recent drought (2002–2005) incorporated measures from the Drought Response Plan (Denver Water 2004b) and represent a strategy that Denver Water may also adopt in future droughts. As previously described, with the increased demand and demand hardening expected under the No Action Alternative, more severe restrictions would be expected than those adopted in the recent drought.

2.5.5 Alternative 1a, Proposed Action – Gross Reservoir Expansion with Environmental Pool for Mitigation (77,000 AF)

Introduction

Denver Water's preferred alternative is to enlarge the existing 41,811 AF Gross Reservoir, which is located in Boulder County, Colorado approximately 35 miles northwest of Denver and 6 miles southwest of the City of Boulder. The proposed Moffat Project would expand the existing reservoir by 77,000 AF to a total storage capacity of 118,811 AF. This includes 72,000 AF for Denver Water's water supply needs and 5,000 AF for an Environmental Pool for mitigation. This would be accomplished by raising the existing concrete gravity arch dam by 131 feet, from 340 to 471 feet. The surface area of the reservoir would be expanded from approximately 418 acres to 842 acres, which would inundate approximately 400 acres of surrounding shoreline. Using existing collection infrastructure, water from the Fraser River, Williams Fork River, and South Boulder Creek would be diverted and delivered during average to wet years via the Moffat Tunnel and South Boulder Creek to Gross Reservoir. To firm this water supply and provide 18,000 AF/yr of new firm yield, an additional 72,000 AF of storage capacity (without the Environmental Pool for mitigation) is necessary.

Existing facilities, including the South Boulder Diversion Canal, Conduits 16 and 22, and Ralston Reservoir would be used to deliver water from the enlarged Gross Reservoir to the Moffat WTP and raw water customers. To meet future demands, in most years, Denver Water would continue to rely on supplies from its entire integrated collection system. In a drought or emergency, Denver Water's existing system would rely on the additional water it would have previously stored in the Moffat Collection System to provide the additional 18,000 AF/yr of yield. The FEIS provides a detailed description of the Moffat Project. Figure 2-2 in Chapter 2 of the Moffat Project FEIS displays the Proposed Action components from the East Portal of the Moffat Tunnel east to the Moffat WTP.

Proposed Action Project Components

Gross Reservoir

As previously discussed, Gross Reservoir is located in Boulder County, Colorado approximately 35 miles northwest of Denver and 6 miles southwest of the City of Boulder. Denver Water owns and operates Gross Reservoir as part of its overall municipal water supply system.

Gross Reservoir, an impoundment of South Boulder Creek, serves as a water storage and regulating facility by collecting snowmelt runoff in the late spring and early summer for municipal and industrial uses during the remainder of the year. As previously described, the existing Gross Reservoir stores 41,811 AF, and has a surface area of 418 acres and a shoreline of approximately 11 miles at an elevation of 7,282 feet (spillway elevation). The proposed 77,000 AF reservoir surface area at normal water level (elevation 7,406 feet) would expand to approximately 842 acres, with approximately 14 miles of shoreline.

Currently, there is negligible seepage at Gross Dam, and this is not expected to change significantly under the Proposed Action. Enlarging this reservoir would require Denver Water to seek a FERC hydropower license amendment.

Water Source

Long-term historic data suggest that approximately 45% of the inflow to Gross Reservoir comes from the South Boulder Creek Basin, and about 55% is diverted from the Colorado River Basin. Denver Water has water rights to both the imported West Slope water and some native South Boulder Creek water. However, Denver Water's South Boulder Creek rights are relatively junior in priority, so flows from South Boulder Creek are generally not available to Denver Water during dry years and are bypassed to downstream users. Water stored in Gross Reservoir is released and diverted to Ralston Reservoir via the South Boulder Canal.

Under the Proposed Action, average and wet year water would be supplied from the existing Moffat Collection System in the Fraser and Williams Fork river basins, and to a lesser degree from South Boulder Creek. This additional supply would be collected and delivered using existing facilities. Water would be released from storage and delivered to Denver Water customers as needed.

Denver Water's existing water rights would be used. No new water rights would be required under the Proposed Action.

Dam Features

Gross Dam is a 340-foot high concrete gravity arch dam with a crest length of 1,050 feet including a 160-foot-long spillway section at an elevation of 7,282 feet mean sea level with the 2-foot high flashboards. The low-level outlet works consist of an intake trash-rack structure and an 8-foot diameter concrete-lined tunnel leading to an outlet works building located on the east bank of South Boulder Creek, about 250 feet downstream from the toe of the dam.

The existing dam was completed in 1954 as a concrete gravity-arch dam rising 340 feet above the streambed. The alignment of the existing dam in a narrow gorge was sited to facilitate a raised dam to a height of 465 feet. A 131-foot concrete dam raise would accomplish the enlargement. This dam enlargement would raise the dam crest to the ultimate height of 471 feet at elevation 7,406 feet with the Environmental Pool. The dam crest would be approximately 1,840-foot long and 25-feet wide. The raised dam would likely have approximately the same dam axis, arch radius, crest width, and downstream slope as the existing dam section.

Environmental Pool

Denver Water is proposing to create an additional 5,000 AF of storage in Gross Reservoir, as mitigation, to support environmental flow releases for enhancement of aquatic habitat downstream in South Boulder Creek. This additional storage would be filled with water provided by the cities of Boulder and Lafayette. None of Denver Water's existing or future water supply would be stored in this 5,000-AF Environmental Pool. To enable storage of additional water, Denver Water proposes to raise the dam an additional 6 feet beyond the proposed 125-foot raise necessary for increasing the storage of water, to a total height of 131 feet. The reservoir elevation during storage of the Environmental Pool would be 7,406 feet. The storage and release of water in the Environmental Pool would be managed under an Intergovernmental Agreement between Denver Water, Boulder, and Lafayette.

Proposed Changes to Denver Water's System Operations

Reservoir Operation Plan

The current general operating plan for Gross Reservoir is to store and regulate water imported through the Moffat Tunnel and native flows from South Boulder Creek for water supply use by the Denver Water service area.

On an average annual basis, Denver Water currently diverts about 60,000 AF of water through the Moffat Tunnel from the West Slope of the Continental Divide, and about 7,000 AF of native flow from South Boulder Creek for a total of 67,000 AF. Under the Proposed Action, using the Moffat Collection System infrastructure capacity and its water rights to West Slope water, Denver Water would import an average of about 76,800 AF through the Moffat Tunnel and divert 8,700 AF/yr of native flow from South Boulder Creek for a total of 85,500 AF.

When Gross Reservoir storage is less than 12,000 AF, there is a dam safety problem of rocks and sediment being transported to the outlet works and resulting damage. In addition, the transported sediment could impact aquatic life in South Boulder Creek below the dam. For these reasons, the bottom 12,000 AF is a minimum pool that is not relied on for water supply purposes.

To avoid spilling, Denver Water reduces West Slope importations as Gross Reservoir is about to fill. Gross Reservoir typically stores the most water in June during spring runoff.

The Proposed Action affects operations, diversions, and stream flow regime throughout Denver Water's system because of the relationship between the North and South system operations.

The additional storage at Gross Reservoir, with an increase in demand of 18,000 AF/yr and changes in the Moffat WTP operations, would affect the amount of water in storage throughout Denver Water's system at certain times of the year, the timing and amount of reusable effluent, and the potential for Denver Water to exchange water up the South Platte River. The primary changes in Denver Water's North and South system operations under the Proposed Action are described below.

North System

Moffat Collection System – The following changes in Denver Water's Moffat Collection System operations would occur under the Proposed Action:

- Denver Water would divert more water from the Williams Fork and Fraser rivers with increased storage at Gross Reservoir. Denver Water's diversions via the Moffat Collection System would primarily be higher during average and wet years following a drought to fill additional available storage at Gross Reservoir. During the winter months and dry years, there would be few differences in diversions and operations in this system.

- Denver Water's operations during the course of a drought would change with additional storage at Gross Reservoir. Denver Water would draw more water to meet demand from Gross Reservoir in the first year of a drought, which would reduce the demand on Denver Water's South Platte storage and Blue River supplies. In advanced stages of the drought, Denver Water's South Platte reservoirs and Dillon Reservoir would get drawn on more intensely as Gross Reservoir storage is depleted.
- Denver Water would also divert more native South Boulder Creek water, either to storage at Gross Reservoir or at the South Boulder Diversion Canal. More water would be released from Gross Reservoir for delivery to Moffat WTP particularly in the winter months because Moffat WTP would operate at a minimum level during those months. Denver Water would also release more water from Gross Reservoir to meet demand in the first year of a drought.
- Williams Fork Reservoir operations (storage and releases) would change. Less water would be available for storage due to increased diversions from the upper Williams Fork River tributaries. As a result, Williams Fork Reservoir would generally achieve fills later in the year and spill less. In addition, pre-emptive releases for power early in the year would be less because the reservoir would not be forecasted to spill as often. Discretionary power releases later in the year would also be less because reservoir contents would generally be lower.

Moffat Water Treatment Plant – The Moffat WTP treats water supplied from Denver Water's North System while the Foothills and Marston WTPs treat water supplied from Denver Water's South System. Moffat, Foothills, and Marston WTP operations are coordinated to meet Denver Water's total treated water demand. The Moffat WTP currently operates from April or May through October 15 at a minimum of 30 mgd, and is shut down the remainder of the year under baseline conditions. Under the Proposed Action, the Moffat WTP would typically operate throughout the year, maintaining a minimum operation of 30 mgd, resulting in a load shift between Denver Water's North and South system WTPs.

South System

Roberts Tunnel Collection System – Under the Proposed Action, the Moffat WTP would typically meet a portion of the demand that would otherwise be met by Foothills and Marston WTPs during the winter months. Consequently, there would be a reduction in winter operations of Foothills and Marston WTPs and, therefore, a reduction in diversions through Roberts Tunnel in those months. More water would remain in Dillon Reservoir and less water would generally be delivered through the Roberts Tunnel to the North Fork South Platte River during the winter months. As a result, Dillon Reservoir would generally be at slightly higher levels at the beginning of the runoff season. Releases from Dillon Reservoir and deliveries through Roberts Tunnel to the North Fork South Platte River would generally be higher during the summer months because the overall system demand would be higher and the seasonal shift in WTP operations described above.

South Platte Collection System – In general, the following changes in Denver Water's South Platte Collection System operations would occur under the Proposed Action.

- Denver Water's operations during the course of a drought would change with additional storage at Gross Reservoir. Denver Water would draw more water to meet demands from Gross Reservoir entering a drought, which would reduce the demand on Antero, Eleven Mile Canyon, and Cheesman reservoirs and Denver Water's Blue River supplies. Consequently, less water would be released from Denver Water's South Platte reservoirs in the beginning stages of a drought. In advanced stages of the drought, Denver Water South Platte reservoirs and Dillon Reservoir would get drawn on more intensely as Gross Reservoir storage is depleted.

- The seasonal shift in WTP operations would affect releases from Denver Water's South Platte reservoirs. Less water would be released from Denver Water's South Platte storage during the winter months because the Moffat WTP is meeting demand that would otherwise be met by Foothills and Marston WTPs during those months. Releases from storage would generally be higher in the summer months because the overall demand level would be higher and due to load shifting described above.
- The amount and timing of reusable effluent available at the Metro Wastewater Reclamation District Plant (Metro Wastewater Treatment Plant [WWTP]) and the Littleton-Englewood (Bi-City) WWTP would change under the Proposed Action. There would be less reusable water available during the winter months and more reusable water available during the summer months due primarily to changes in the amount of Blue River water that would be used. Exchanges of reusable water to Strontia Springs Reservoir (Foothills WTP) and Conduit 20 (Marston Reservoir and Marston WTPs) would generally increase under the Proposed Action for the following reasons: (1) the available reusable effluent would increase during summer months because more water would be diverted through Roberts Tunnel from the Blue River Basin, and (2) Foothills and Marston WTPs would operate at higher rates under the Proposed Action because the overall level of demand would be higher.
- The timing and quantity of Denver Water's direct diversions at Strontia Springs Reservoir would change in response to the treatment plant load shift and the higher level of demand that would be met. Direct diversions would generally decrease in winter months due to the WTP load shift and increase during the summer months due to the increased demand that would be met by Foothills and Marston WTPs.
- Water would be moved between Strontia Springs, Chatfield, and Marston reservoirs differently under the Proposed Action due to the treatment plant load shift. The amount moved would be comparable to Full Use of the Existing System, but the timing would change.

Foothill and Marston Water Treatment Plants – Moffat, Foothills, and Marston WTP operations are coordinated to meet Denver Water's total treated water demand. Under the Proposed Action, the Moffat WTP would operate throughout the year, maintaining a minimum operation of 30 mgd. Because the Moffat WTP would operate at a minimum rate during winter months, Denver Water's southern WTPs, which include Foothills and Marston WTPs, would operate less during winter months. In the summer, Foothills and Marston WTPs would operate at higher rates under the Proposed Action because of the overall higher level of demand that would be met and load shifting as previously described.

2.5.6 Alternative 1c – Gross Reservoir Expansion (40,700 AF)/New Leyden Gulch Reservoir (31,300 AF)

Introduction

Alternative 1c would combine additional Moffat Collection System supplies and two reservoir storage facilities to provide 18,000 AF/yr of new firm yield. The existing Gross Dam would be raised 85 feet to provide an additional 40,700 AF of new storage capacity at Gross Reservoir. A new off-stream reservoir would be constructed in Leyden Gulch to provide 31,300 AF of active storage capacity. This combination of reservoir storage represents a balance of construction cost, relocation requirements, operational considerations, and potential environmental impacts based on existing information and analyses. If Alternative 1c is selected for implementation, the exact combination of storage sizes may vary, based on more precise design data, but would still total 72,000 AF of new reservoir storage.

Using existing Denver Water collection infrastructure, water from the Fraser and Williams Fork river basins and South Boulder Creek would be delivered during average and wet years to an enlarged Gross Reservoir and then delivered via the South Boulder Diversion Canal to a new Leyden Gulch Reservoir. A combination of existing and new facilities would be used to deliver water from the enlarged Gross Reservoir and the new Leyden Gulch Reservoir to the Moffat WTP. Water would be released from storage and delivered to Denver Water customers when needed.

Alternative 1c Components

Gross Reservoir

The existing Gross Reservoir stores 41,811 AF and has a surface area of 418 acres at an elevation of 7,282 feet (spillway elevation). Under Alternative 1c, Gross Reservoir would be expanded to approximately 82,511 AF to provide an additional 40,700 AF of storage. The proposed reservoir surface area at normal water level (elevation 7,357 feet) would expand to approximately 651 acres, inundating approximately 233 acres of surrounding shoreline. Currently, there is negligible seepage at Gross Dam, which is not anticipated to change under Alternative 1c.

Water Source – The source of water for this alternative would be the same as that described for the Proposed Action. Average and wet year water would be supplied from the existing Moffat Collection System in the Fraser and Williams Fork river basins and to a lesser degree from South Boulder Creek. Existing Denver Water water rights would be used. No new water rights would be required, but it would require changing existing storage rights from Gross Reservoir to Leyden Gulch Reservoir.

Dam Features – Under Alternative 1c, Gross Dam would be raised by 85 feet. This mass concrete dam enlargement would raise the dam crest to the ultimate height of 425 feet, at elevation 7,391 feet. The crest length of the enlarged dam would be 1,640 feet and would have a width of 25 feet. The raised dam would have approximately the same dam axis, arch radius, crest width, and downstream slope as the existing dam section. The upstream and downstream slopes of the raised dam portion would be similar to the Proposed Action.

Leyden Gulch Reservoir

A new 31,300-AF reservoir would be constructed at Leyden Gulch in Jefferson County to complement the enlarged Gross Reservoir. The proposed reservoir would be built approximately 1 mile southwest of the intersection of State Highways (SHs) 72 and 93, immediately south of the Union Pacific rail line. The new reservoir would have a water surface area of approximately 332 acres at a normal water level elevation of 6,127 feet.

Water Source – The water source would be the same as stated for Gross Reservoir. Average and wet year water would be supplied from the existing Moffat Collection System in the Fraser and Williams Fork river basins, and to a lesser degree, from South Boulder Creek. The Leyden Gulch Reservoir would be filled from water stored in Gross Reservoir, which would be released and delivered via the South Boulder Diversion Canal. No new water rights would be acquired, but it would require changing existing storage rights from Gross Reservoir to Leyden Gulch Reservoir.

Dam Features – The proposed Leyden Gulch Dam would be 177 feet high and constructed as an earthfill dam with a dam crest located at an elevation of 6,135 feet. The dam crest would be approximately 5,400 feet long and 40 feet wide. The upstream and downstream slopes of the dam would be variable. Near the upstream and downstream toes of the dam, the slope would be approximately 12.5%, whereas near the crest, the slope would increase to approximately 40%. Denver Water would apply topsoil to the Leyden Gulch Dam face and then revegetate the

downstream face with native grass seed mix. The final appearance of the dam face would be very similar to those found at Chatfield or Bear Creek dams in the southwest Denver Metropolitan area.

Proposed Changes to Denver Water's System Operations

The proposed changes to Denver Water's system operations would be the same as described for the Proposed Action, except that Moffat Collection System supplies would also be stored in a new Leyden Gulch Reservoir. Water stored in Gross Reservoir would be released and delivered via the South Boulder Diversion Canal to Leyden Gulch Reservoir. Water would be released from Gross Reservoir for storage in Leyden Gulch Reservoir in an effort to maintain Leyden Gulch Reservoir full. This would stage water closer to the Moffat WTP and maximize the space that would be available in Gross Reservoir for collection of Moffat Collection System supplies. As a result, reservoir contents at Gross Reservoir would fluctuate more in comparison with Leyden Gulch and Ralston reservoirs.

Water would be released from Leyden Gulch and Ralston reservoirs as needed to meet demands at Moffat WTP. Releases from Leyden Gulch Reservoir would be conveyed via Conduits 16 and 22 to either Ralston Reservoir or directly to the Moffat WTP.

2.5.7 Alternative 8a – Gross Reservoir Expansion (52,000 AF)/Reusable Return Flows/Gravel Pit Storage (5,000 AF)

Introduction

This alternative would combine storage of Moffat Collection System supplies in an expansion of the existing Gross Reservoir with reusable return flows to provide 18,000 AF/yr of new firm yield. Approximately 13,000 AF/yr of new firm yield would be provided by the expansion of Gross Reservoir, while 5,000 AF/yr of new firm yield would be provided by reusable return flows stored in gravel pits along the South Platte River.

The existing Gross Dam would be raised 101 feet to provide an additional 52,000 AF of new storage capacity in an expanded Gross Reservoir. When available, additional water diverted from the Fraser River, Williams Fork River, and South Boulder Creek at existing Denver Water facilities under existing Denver Water water rights, would be stored in the expanded Gross Reservoir.

A new diversion structure and gravel pit storage facilities would be constructed along the South Platte River. Reusable return flows would be diverted from the South Platte River, when available, to fill the new gravel pit storage facilities. When needed, water would be recovered from gravel pit storage, treated at a new AWTP, and conveyed via new pipelines to the Moffat Collection System.

The gravel pit storage facilities (gravel pits, diversion structure, pipelines, and AWTP) are considered representative of typical facilities of other existing facilities along the South Platte River. The actual location and configuration of the gravel pits, the AWTP, and associated facilities would be determined during the design phase should this alternative be permitted by the Corps.

Alternative 8a Project Components

Gross Reservoir

The existing Gross Reservoir stores 41,811 AF and has a surface area of 418 acres at elevation 7,282 feet (spillway elevation). Under Alternative 8a, Gross Reservoir would be expanded to approximately 93,811 AF to provide an additional 52,000 AF of storage. The proposed reservoir surface area at normal water level would expand to approximately 712 acres, inundating approximately 294 acres of surrounding shoreline at an elevation of 7,374 feet.

Water Source – The water source would be the same as the Proposed Action. Average and wet year water would be supplied from the existing Moffat Collection System in the Fraser and Williams Fork river basins, and to a lesser degree, from South Boulder Creek. Denver Water's existing water rights would be used. No new water rights would be required.

Dam Features – Under Alternative 8a, the Gross Dam would be raised by 101 feet. This enlargement would raise the dam crest to a height of 441 feet, at an elevation of 7,374 feet. The crest length of the enlarged dam would be 1,708 feet and would have a width of 25 feet. The raised dam would have approximately the same dam axis, arch radius, crest width, and downstream slope as the existing dam section. The upstream and downstream slopes of the raised dam portion would be similar to the Proposed Action.

Gravel Pit Storage Facilities

Reusable return flows would be diverted from the South Platte River and stored in gravel pit reservoirs. The gravel pits would provide both regulation and firming storage prior to delivery to the Moffat Collection System. Modeling of this alternative indicates that approximately 5,000 AF of storage would be required to create the firm yield contemplated for the reusable effluent portion of this alternative. Given the typical size of gravel pit reservoirs along this reach of the South Platte River, several gravel pit storage sites would be required to develop this volume. For purposes of the FEIS analysis, three existing gravel pits, the Worthing, South Tower, and North Tower pits, were identified as typical pits that could be converted into gravel pit storage facilities for this alternative. The final combination of gravel pit lakes would be determined during the design phase should this alternative be permitted. The gravel lake storage sites would be connected hydraulically using a system of minor pump stations and pipelines and described below in further detail.

State regulations require an impermeable barrier to prevent infiltration of groundwater into water storage facilities. This barrier would be provided by slurry walls. Slurry walls are narrow trenches backfilled with a low permeability material to form a barrier to groundwater movement. The slurry consists of a mixture of powdered bentonite and water. In addition, the side slopes of the mined gravel pits would be backfilled with soil to create a stable slope. It is common practice for the aggregate operator to complete the required barrier as part of its operating or reclamation plan. For purposes of this FEIS analysis, it was assumed that when Denver Water acquires the gravel pits, the pits would be completely mined and reclaimed for use as an empty water storage facility.

Water Source – Reusable return flows would be diverted from the South Platte River, when available, to fill the new gravel lake storage facilities. Reusable return flow would include water imported from the Blue River and the Meadow-Cabin Creek basins in the Fraser River Basin, and fully consumable agricultural water. They include both water applied to indoor use and delivered to the river via the WWTPs, and landscape irrigation return flows. The amount of water from each of these sources varies from year to year depending on Denver Water's operations, which are responsive to hydrologic conditions. The amount of available reusable effluent depends not only on the amount of reusable source water used, but also on use of reusable return flow credits to run exchanges. The PACSM showed that the amount of reusable return flow available each year could range from zero to 37,555 AF. In Alternative 8a, approximately 5,000 AF/yr of new firm yield would be provided by reusable return flows stored in gravel pits along the South Platte River. For the purposes of this FEIS analysis, the amount of reusable supplies included in Alternative 8a was based on a review of the amount of reusable water available, available gravel pit storage along the South Platte River, and potential water quality issues associated with blending reusable supplies with Moffat Collection System supplies. The final configuration of this alternative would be determined during the design phase should this alternative be permitted.

Diversion Structure – To capture the reusable return flow, a new diversion would be constructed in the South Platte River near the Worthing Pit storage facility. The diversion would extend across the active South Platte River channel (low flow channel plus first terrace).

Advanced Water Treatment Plant – Water withdrawn from gravel pit storage would be treated at the new AWTP, then conveyed via Conduit O to the South Boulder Diversion Canal to Ralston Reservoir, and then to the existing Moffat WTP. When water originating in the Fraser River, Williams Fork River, and South Boulder Creek basins is also being delivered to the Moffat WTP, the two water sources would mix in the canal prior to discharge into Ralston Reservoir. South Platte River return flow water quality is substantially different and of lesser quality than existing Moffat Collection System supplies. Since the existing Moffat WTP would be incapable of treating the resulting blended supply to meet drinking water standards, a new 13.6 mgd AWTP would be required to treat the South Platte River return flows prior to their introduction to the Moffat Collection System. The treatment process would involve sedimentation, low-pressure membrane pre-treatment, reverse osmosis, advanced oxidation, disinfection, and ZLD for the residual disposal.

For purposes of analysis in the FEIS, it is assumed that the new AWTP would occupy approximately 4 acres adjacent to the Worthing Pit and would consist of several buildings and structures no more than two stories in height (about 25 feet to 30 feet). A buried pipeline would deliver the waste stream or brine from the AWTP to the disposal site. The 13.6 mgd plant would require approximately 70 acres of evaporation ponds and drying beds, located near the plant.

If Alternative 8a is permitted by the Corps, Denver Water would locate the disposal facility on an upland site in a commercial, industrial, or other area compatible with surrounding land uses, in close proximity to the AWTP. The location would be evaluated to avoid or minimize interferences with sensitive environmental areas including wetlands, threatened and endangered species habitat, and cultural resources. Denver Water would conduct the appropriate level of analyses and obtain all necessary permits prior to constructing and operating the AWTP.

Proposed Changes to Denver Water's System Operations

The primary changes in Denver Water's North and South system operations are described under the Proposed Action (Section 2.3 of the Moffat Project FEIS), with the following exceptions pertinent to Alternative 8a. Refer to Section 4.1.3 of the FEIS for details on the proposed hydrologic changes.

Gravel Pit Storage

Water stored in the gravel pit lakes would generally be used for supply in dry years. Based on runoff forecasts and other Denver Water reservoir contents, Denver Water would decide in the spring whether or not to draw water from the gravel pit lakes for delivery to the Moffat Collection System. If needed, the water would be delivered to the Moffat system as limited by treatment and conveyance capacity. Diversions would be made from the river to the extent that reusable effluent is available and storage space exists in the gravel pits. In years when the stored water is not used, water would be diverted into the pits only to replace evaporative losses. The AWTP would operate only when deliveries are being made to the South Boulder Diversion Canal.

2.5.8 Alternative 10a – Gross Reservoir Expansion (52,000 AF)/Reusable Return Flows/Denver Basin Aquifer Storage (20,000 AF)

Introduction

Alternative 10a would combine storage of Moffat Collection System supplies in an expansion of the existing Gross Reservoir with deep aquifer storage of reusable return flows to provide 18,000 AF/yr of new firm yield. Approximately 13,000 AF/yr of new firm yield would be provided by the enlargement of Gross Reservoir, while 5,000 AF/yr of new firm yield would be provided by reusable return flows and deep aquifer storage and recovery (see Figure 2-15 in Chapter 2 of the Moffat Project FEIS).

The existing Gross Dam would be raised 101 feet to provide an additional 52,000 AF of new storage capacity. When available, under Denver Water's existing water rights, additional water diverted from the Fraser River, Williams Fork River, and South Boulder Creek at existing Denver Water facilities under existing Denver Water water rights would be stored in an enlarged Gross Reservoir.

When available, reusable return flows at the Denver Water Recycling Plant would be treated at a new AWTP and conveyed via a new pipeline distribution system to an injection/recovery well field in the City of Denver. This water would be injected into the Denver Basin deep aquifers for storage. The estimated storage capacity would be 20,000 AF. When needed, previously stored water would be recovered from the groundwater basin and conveyed through new pipelines to the Moffat Collection System.

The locations of the new AWTP, well sites, and distribution pipeline system are considered representative and were used to illustrate how this alternative would be configured for purposes of the FEIS analysis. The exact location of these components would be determined during the design phase should this alternative be permitted.

Denver Water currently uses the bulk of their reusable supplies during the summer months primarily to meet non-potable demands and as an exchange supply. As with Alternative 8a, reusable return flows for this alternative would be available primarily during the winter months from November through March when Denver Water's non-potable demands and exchange potential are lowest.

Gross Reservoir

The existing Gross Reservoir stores 41,811 AF and has a surface area of 418 acres at elevation 7,282 feet (spillway elevation). Under Alternative 10a, Gross Reservoir would be expanded to approximately 93,811 AF to provide an additional 52,000 AF of storage. Refer to Section 2.5.2.1 of the Moffat Project FEIS for a discussion of a 52,000-AF enlargement of Gross Reservoir.

Aquifer Storage and Recovery System

Water Source

When available, reusable return flows would be collected at the Denver Water Recycling Plant, treated at a new AWTP, and conveyed via a new pipeline distribution system to an injection/recovery well field in the City of Denver. The water would be injected into the Denver Basin deep aquifers for storage. When needed, previously stored water would be recovered from the groundwater basin and conveyed through new pipelines to the Moffat Collection System. Approximately 5,000 AF/yr of new firm yield would be provided by reusable return flows. The amount of reusable supplies included in Alternative 10a was based on a review of the amount of reusable water available, treatment and conveyance costs associated with the reusable supplies, and

potential water quality issues associated with blending reusable supplies with Moffat Collection System supplies. The final configuration of this alternative would be determined during the design phase should this alternative be permitted.

Advanced Water Treatment Plant

Under Alternative 10a, water would be injected into the Denver Basin aquifers. Subsequently, because the Denver Basin aquifers are a source of public water supply, water added to the Denver Basin must be treated to at least minimum drinking water standards. Reusable return flows from the Denver Water Recycling Plant would be treated at a new 13.6 mgd AWTP to meet or exceed drinking water standards prior to injection into the aquifer, and would be the same as described for Alternative 8a. In general, the treatment process would involve sedimentation, low-pressure membrane pretreatment, reverse osmosis, advanced oxidation, disinfection, and ZLD for the residual disposal.

Well Sites

Water from the new AWTP would be conveyed to the injection/recovery well field, injected into the upper Arapahoe, lower Arapahoe, and Laramie-Fox Hills aquifers of the Denver Basin, and recovered as needed. At each well site, one well would be drilled into each aquifer creating a three-well cluster at each site. Individual wells in a cluster would be separated by about 50 feet to accommodate drilling and construction activities. A total of 27 well facilities (81 individual wells) would be necessary for the Project located on 23 sites within the City and County of Denver. Four of the proposed locations would contain two well facilities.

Proposed Changes to Denver Water's System Operations

The primary changes in Denver Water's North and South system operations are described under the Proposed Action (Section 2.3.3 of the Moffat Project FEIS), with the following exceptions pertinent to Alternative 10a. Refer to Section 5.1 of the FEIS for details on the proposed hydrologic changes.

Aquifer Storage and Recovery System Operations Plan

Water stored in the Denver Basin aquifers would generally be used for supply in dry years. Based on runoff forecasts and Denver Water reservoir contents, Denver Water would decide in the spring whether or not to recover water from the Denver Basin aquifers for delivery to the Moffat Collection System. When needed, water would be collected and pumped to the Moffat Collection System delivery point via Conduit M.

Deliveries would be made from the Denver Water Recycling Plant to the new AWTP and then injected into the Denver Basin aquifers to the extent that reusable effluent is available and storage of reusable water in the Denver Basin aquifers is less than 5,000 AF. In years when the stored water is not used, no water would be injected into the Denver Basin aquifers unless needed to recharge the aquifer.

2.5.9 Alternative 13a – Gross Reservoir Expansion (60,000 AF)/Transfer Agricultural Water Rights/Gravel Pit Storage (3,625 AF)

Introduction

Alternative 13a would combine storage of Moffat Collection System supplies in an expansion of the existing Gross Reservoir with a purchase and transfer of existing South Platte River agricultural water rights stored in gravel pit storage facilities to provide 18,000 AF/yr of new firm yield (see Figure 2-18 of the Moffat Project FEIS). Approximately 15,000 AF/yr of new firm yield would be

provided by Moffat Collection System supplies and the enlargement of Gross Reservoir, while 3,000 AF/yr of new firm yield would be provided by gravel pit storage and transferred South Platte River agricultural water rights.

The existing Gross Dam would be raised 110 feet to provide an additional 60,000 AF of new storage capacity in an expanded Gross Reservoir. When available, under Denver Water's existing water rights, additional water diverted from the Fraser River, Williams Fork River, and South Boulder Creek at existing Denver Water facilities, under existing Denver Water water rights, would be stored in an expanded Gross Reservoir.

Senior agricultural water rights, owned by ditch companies diverting from the South Platte River downstream of Denver, would be purchased and converted to municipal/industrial use. Water rights sufficient in quantity and priority would be purchased to produce approximately 3,000 AF/yr of firm yield when combined with 3,625 AF of new gravel pit storage. Gravel pit storage is needed to firm the agricultural water rights supply, provide operational storage, and meet winter return flow obligations associated with historical use of the agricultural water rights. A new diversion from the South Platte River, as described in Alternative 8a, would divert water to the gravel pit storage facility.

The gravel pit storage facilities (gravel pits, diversion structure, and pipelines) are considered representative of typical existing facilities found along the South Platte River. The actual location and configuration of the gravel pits, AWTP, and associated facilities would be determined during the design phase should this alternative be permitted by the Corps.

Alternative 13a Project Components

Gross Reservoir

The existing Gross Reservoir stores 41,811 AF and has a surface area of 418 acres at an elevation of 7,282 feet (spillway elevation). Under Alternative 13a, Gross Reservoir would be expanded to approximately 101,811 AF to provide an additional 60,000 AF of storage. The proposed reservoir surface area at normal water level would expand to approximately 755 acres, inundating approximately 337 acres of surrounding shoreline at an elevation of 7,385 feet.

Water Source – The water source would be the same as for the Proposed Action. Average and wet year water would be supplied from the existing Moffat Collection System in the Fraser and Williams Fork river basins, and to a lesser degree, from South Boulder Creek. Existing Denver Water water rights would be used. No new water rights would be required.

Dam Features – Under Alternative 13a, the Gross Dam would be raised by 110 feet. This mass concrete dam enlargement would raise the dam crest to a height of 450 feet, at an elevation of 7,385 feet. The crest length of the enlarged dam would be 1,753 feet and would have a width of 25 feet. The raised dam would have approximately the same dam axis, arch radius, crest width, and downstream slope as the existing dam section. The upstream and downstream slopes of the raised dam portion would be similar to the Proposed Action.

Gravel Pit Storage Facilities

Agricultural water supply would be diverted from the South Platte River and stored in gravel pit reservoirs, similar to Alternative 8a. Given the typical size of gravel pits along this reach of the South Platte, several gravel pit storage sites would be required to develop the volume of storage necessary to generate additional firm yield for Denver Water. Storage is required to firm the agricultural water supply to meet Denver Water's demand schedule through the critical period, as well as to provide operational storage and meet winter return flow obligations incurred through the

water right transfer process. For purposes of the FEIS analysis, three existing gravel pits, the Worthing, South Tower, and Challenger, were identified as representing one combination of pits that would provide approximately 3,625 AF of new gravel pit storage required for this alternative (Boyle 2006). It was also assumed that when Denver Water acquires the gravel pits, they would be completely mined and reclaimed for use as a water storage facility. The gravel pits would be connected hydraulically using a system of pump stations and pipelines; this system is described in further detail below.

Water Source – Four ditches have their head gates on the South Platte River between Denver and the City of Brighton: the Fulton Ditch, Brantner Ditch, Brighton Ditch, and Lupton Bottoms Ditch. Each of these ditches are operated by individual mutual ditch companies, whereby shareholders receive their prorated share of the waters diverted by the ditch based on the number of shares they own in the ditch company. These ditch systems all have water rights that were originally decreed to provide agricultural irrigation water. With growing pressures for water supplies for the Front Range urban area, an increasing number of shares in these systems have been purchased and changed, through a Water Court procedure, from irrigation to municipal use. Approximately 3,000 AF/yr of new firm yield would be provided by transferred agricultural water rights. For purposes of the FEIS analysis, these ditches and the associated water rights were considered representative of agricultural ditches along the South Platte River. The amount of transferred agricultural water included in Alternative 13a was based on a review of water rights, costs associated with purchasing agricultural water rights, treatment and conveyance costs associated with South Platte River water, and potential water quality issues associated with blending those supplies with Moffat Collection System supplies. The final configuration of this alternative would be determined during the design phase should this alternative be permitted.

The yield of shares in these ditches varies depending on the historical practices of the specific farmers whose shares are purchased (Boyle 2006). However, analysis shows that approximately 3,000 AF of firm yield (i.e., during dry years) could be acquired if Denver Water purchases approximately 24% of the shares of each ditch that currently remain in agriculture. Denver Water would have to obtain a "change decree" from Division 1 Water Court for the acquired portions of the water rights owned by the ditches. The decree process involves quantifying the historical use of the water right, identifying the new location and pattern of use, demonstrating that the change would result in no greater depletion of the river than that caused by the historical irrigation use, and incorporating limits and conditions on the new use that would protect others from injury.

The change in water rights would carry with it an obligation to replicate the lagged return flows that occurred when the water was historically used for irrigation. These contributions to the river occur during the non-diversion season. Thus, one of the functions of gravel pits would be to store water during the diversion season for release during fall and winter months to meet return flow obligations in accordance with the change decree.

Another outcome of the change in water rights would be the dry-up of lands irrigated historically by the changed water rights. The land to which the water was once applied would be required by the Water Court to be formally taken out of production. It is estimated that approximately 3,900 acres of agricultural land would be taken out of irrigation. However, the actual amount would depend on what agricultural shares would be purchased and the historical practice on those lands.

Proposed Changes to Denver Water's System Operations

The primary changes in Denver Water's North and South system operations are described under the Proposed Action, with the following exceptions pertinent to Alternative 8a.

Gravel Pit Storage

Water stored in the gravel pit lakes would generally be used for supply in dry years. Based on runoff forecasts and Denver Water reservoir contents, Denver Water would decide in the spring whether or not to draw from the gravel pits for delivery to the Moffat Collection System. If needed, the water would be delivered to the Moffat system as limited by treatment and conveyance capacity. Diversions would be made from the river to the gravel pits to the extent that reusable effluent is available and storage space exists in the gravel pits. In years when the stored water is not used, water would be diverted into the pits only to replace evaporative losses. In every year, the pits would release to the river from October through March, to fulfill winter return flow obligations in accordance with the change decree. Typically, the release requirement would be based on the total volume diverted during the previous diversion season.

2.6 SELECTION OF PRACTICABLE ALTERNATIVES

Although the No Action Alternative does not meet the Project Purpose and Need, all five action alternatives plus the No Action Alternative were included in this Section 404(b)(1) analysis to ensure that a reasonable range of alternatives were considered in the Section 404(b)(1) analysis.

3. COMPLIANCE WITH THE GUIDELINES

The purpose of the Section 404(b)(1) Guidelines is to restore and maintain the chemical, physical, and biological integrity of waters of the U.S. through the control of discharges of dredged or fill material.

3.1 RESTRICTIONS ON DISCHARGE (230.10)

3.1.1 LEDPA (230.10[a]1-2)

In addition to satisfying NEPA requirements, projects subject to permitting by the Corps under the CWA also must comply with the Section 404(b)(1) Guidelines (40 CFR, Part 230) for discharge of dredge and fill material into waters of the U.S. The Section 404(b)(1) Guidelines require that the Corps can only permit the LEDPA to the aquatic ecosystem. The Section 404(b)(1) Guidelines specify "no discharge of dredge or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences." An alternative is considered practicable if "it is capable of being done after taking into consideration cost, existing technology, and logistics in the light of overall project purposes." Practicable alternatives under the guidelines assume that "alternatives that do not involve special aquatic sites are available, unless clearly demonstrated otherwise." The Section 404(b)(1) Guidelines also assume that "all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise."

The Corps has integrated NEPA and Section 404(b)(1) Guidelines into the alternatives analyses found in Sections 2.4 and 2.5 of this appendix. Integration of both NEPA and Section 404(b)(1) Guidelines ensures that the alternatives selected for evaluation in the FEIS provide a reasonable range of alternatives and that the alternatives are practicable.

Impacts to the aquatic ecosystem are primarily summarized in two sections in the FEIS; impacts to wetlands and stream flow changes. A thorough discussion of wetland impacts is included in Section 5.8 of the Moffat Project FEIS, with a summary of the impacts shown in Table 2 and

Table 4 of this document. Of the six alternatives analyzed in the FEIS, the Proposed Action and Alternatives 8a and 10a have approximately the same wetland impacts, with higher impacts for Alternatives 1c and 13a (see Table 2). A thorough discussion of flow changes in affected drainages is found in Sections 4.3.1 and 4.3.2 of this document.

Table 2
Summary of Impacts to Wetlands and Other Waters of the U.S. (acres)

	Proposed Action (Alternative 1a)		Alternative 1c		Alternative 8a		Alternative 10a		Alternative 13a	
	P	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**
Total Wetland Impacts by Alternative	1.95	0.12	6.15	13.43	1.77	0.4	1.75	0.19	83.87	0.42
Total Waters of the U.S. Impacts by Alternative	3.53	0.49	3.12	2.04	3.20	1.18	3.16	2.19	11.40	1.72
Total	**5.48**	**0.61**	**9.27**	**15.47**	**4.97**	**1.58**	**4.91**	**2.38**	**95.27**	**2.14**

Notes:
P = permanent
T = temporary

3.1.2 Basic Purpose and Water Dependency (230.10[a][3])

The basic purpose of a project must be known to determine if a given project is "water dependent" and requires access or proximity to, or siting within, a special aquatic site in order to fulfill its basic purpose (40 CFR 230.10[a][3]). The Basic Purpose of the Moffat Project is water supply, and since water supply structures and their operations do not of necessity need to involve placement of dredged or fill material into special aquatic sites, the Project is not water dependent.

3.1.3 Water Quality Standards (230.10[b]1-2)

As evaluated in Section 5.2 of the FEIS, none of the Project alternatives violate applicable State water quality standards or standards prohibited under Section 307 of the CWA. Denver Water would be required to implement a stormwater management plan (SWMP) for construction activities, which would be prepared in compliance with Colorado Department of Public Health and Environment's (CDPHE's) General Permit for Stormwater Discharges Associated with Construction Activities. The plan and permit would specify Best Management Practices (BMPs) and inspection requirements to reduce pollutants in stormwater runoff from the construction sites. In addition, water quality requirements will be part of the 401 Certification process.

For Gross Reservoir and South Boulder Creek upstream and downstream of the dam and reservoir, water quality monitoring would be continued for the larger reservoir. Similar water quality monitoring programs would be adopted for Leyden Gulch Reservoir, if constructed.

3.1.4 Threatened and Endangered Species (230.10[b]3)

As evaluated in Section 5.10 and Appendix G of the Moffat Project FEIS, the Project alternatives jeopardize the existence of Federally listed endangered or threatened species or their habitats. The U.S. Fish and Wildlife Service (USFWS) issued a Final Biological Opinion (BO) for the Moffat Project on December 6, 2013, which replaces the BO that was issued on July 31, 2009. The Corps submitted a request for reinitiation of consultation on August 14, 2012, in response to a February 16, 2010 letter from USFWS commenting on the Draft Environmental Impact Statement

(DEIS). The USFWS indicated that it would provide two BOs for the Project, one addressing depletions to the Platte and Colorado rivers and additional information on Preble's meadow jumping mouse, and the second addressing impacts to greenback cutthroat trout in the Fraser River and Williams Fork River systems. The Corps submitted a Revised Biological Assessment (BA) for depletions and Preble's on August 14, 2013 and on December 6, 2013, the USFWS issued its Final BO. Refer to Appendix G-2 for a copy of the Final BO. The Corps is preparing and will submit a Supplemental BA for greenback cutthroat trout. Section 7 consultation will be completed prior to issuance of the Record of Decision.

3.1.5 Marine Sanctuaries (230.10[b]4)

Not applicable.

3.1.6 Significant Degradation of Waters of the U.S. (230.10[c])

With the appropriate selection of the alternative that is the least-environmentally-damaging activity, with the administration of appropriate actions to avoid, minimize and mitigate impacts, and provided the permittee follows the required permit conditions and BMPs, it is the opinion of the Corps that the activity would not cause or contribute to significant degradation of waters of the U.S., including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, esthetic, and economic values.

A thorough discussion of flow changes in affected drainages is found in Sections 4.6.1 and 4.6.3 of this document.

In addition to the suggested mitigation measures for each resource in the FEIS, Denver Water prepared a Fish and Wildlife Mitigation Plan (FWMP) in accordance with the Colorado Revised Statutes Section 37-60-122.2. The plan was adopted by the Colorado Wildlife Commission and Colorado Water Conservation Board in 2011. The FWMP presents a broad range of mitigation actions to address potential fish and wildlife impacts of the Moffat Project. It represents the official State position on fish and wildlife mitigation for the Moffat Project. Since the FWMP is not enforceable by itself, the mitigation measures would likely be incorporated into the Corps' Section 404 Permit, if issued. Refer to Appendix M of the Moffat Project FEIS for a copy of the FWMP.

3.1.7 Avoidance and Minimization (230.10[d])

Water Quality

Denver Water would be required to implement a SWMP for construction activities, which would be prepared in compliance with CDPHE's General Permit for Stormwater Discharges Associated with Construction Activities. The plan and permit would specify BMPs and inspection requirements to reduce pollutants in stormwater runoff from the construction sites. Additional water quality requirements may be part of the 401 Certification process.

There is no evidence from the existing data or model predictions that there would be adverse water quality impacts to Gross Reservoir from any of the alternatives, with the exception of short-term increases in methylmercury (MeHg) and possibly organic carbon concentrations due to inundation of new areas associated with reservoir expansion. As the data are limited, however, it is appropriate to maintain a monitoring program to validate assumptions and investigate possible impacts. Key aspects of Gross Reservoir to continue monitoring would include:

1. Inflow and outflow quantity and water level in the reservoir.
2. Incoming water quality, during the range of flow conditions, capturing four high flow time periods and four low flow time periods. Parameters to continue to include are alkalinity, conductivity, pH, total suspended solids (TSS), turbidity, metals, phosphorus, hardness, and dissolved oxygen (DO). Additionally, if there is any anticipated need for future temperature modeling, it would be useful to add continuous temperature monitoring at the inflow location to Gross Reservoir on South Boulder Creek.
3. Outflow water quality during the range of flow conditions, capturing at least four high flow time periods and four low flow time periods. Parameters to continue to include are alkalinity, conductivity, pH, TSS, turbidity, metals, phosphorus, hardness, DO, coliforms, nitrogen, ammonia, and total organic carbon (TOC).
4. Reservoir water quality over the depth profile of the photic zone with three samples in the photic zone. Photic zone samples will be monitored for phosphorus and chlorophyll. Additionally, water quality at two locations should be sampled the full depth of the reservoir into the hypolimnion for DO, temperature, turbidity, pH, and specific conductance.
5. Water clarity (by Secchi disk) from the surface of the reservoir should be assessed periodically throughout the periods when the reservoir is not frozen over.

On the West Slope, Denver Water committed to continuous stream temperature monitoring on the Fraser River, Ranch Creek, and Colorado River, and reductions in diversions if specific temperature thresholds are reached. Refer to the FWMP in Appendix M of the Moffat Project FEIS.

Floodplain

Due to the anticipated flow changes resulting from the action alternatives and the No Action Alternative, flows would generally be reduced during high flow periods on the West Slope. As a result, the potential for creating additional flood hazard is considered minor.

On the East Slope, Denver Water operates the Moffat Tunnel and Roberts Tunnel so that specific flow rates, including natural flows, are not exceeded. Therefore, impacts on flood flows on the East Slope due to the alternatives would also be relatively minor.

Stream Morphology and Sedimentation

Due to anticipated flow reductions resulting from the action alternatives and the No Action Alternative on the West Slope, minor amounts of localized sediment deposition are anticipated. Deposition that occurs is expected to be limited in extent and magnitude and should not pose significant changes to channel morphology. Continued aggradation and/or vegetative encroachment is expected in stream segments directly below diversions with no bypass flow requirements. Anticipated flow increases in North Fork South Platte River and South Boulder Creek will increase erosive potential and may cause localized bank instability, which can be addressed by stabilization practices. Water quality and sedimentation control will be part of the 401 Certification process.

In its FWMP, Denver Water committed to monitoring streambank stability and erosion along South Boulder Creek and North Fork South Platte River.

Geology

The following recommendations are made with respect to geologic impacts:

- Various erosion protection measures should be implemented during construction and operation of the facilities, such as design of slopes with geotextile fabric, vegetation, riprap, or a

combination of these. Visual monitoring of the facilities may be conducted to evaluate the impact of erosion and the effectiveness of erosion protection measures.

- In the dam and reservoir construction areas, cut slopes should be designed to provide adequate slope stability for the anticipated construction and long-term loading conditions at each site.
- Seepage associated with the proposed Leyden Gulch Reservoir may be mitigated with design of seepage reduction measures, such as cut off walls, grouting, etc. Monitoring of seepage reduction measures and changes in groundwater levels before, during, and after construction may be conducted using piezometers.
- Reservoir rim instability associated with Leyden Gulch Reservoir may be mitigated with design of slope stabilization measures, such as making slopes flatter, installing drains, and constructing slope support features. Monitoring of unstable slopes may include mapping, installation of survey monuments, periodic air photo review, and installation of slope movement instruments such as inclinometers and survey monuments.
- Erosion and stability of excavations associated with all pipelines may be mitigated with design of erosion control and excavation stability measures. This is especially necessary where pipelines cross drainageways.
- The relocation design and construction of SH 93 should include methods of stabilizing the existing clay mine workings and locating a stable embankment on top of the workings in order to protect the hogback feature located east of the proposed Leyden Gulch Reservoir. Issues related to seepage, reservoir rim stability, seismic activity, and relocation of SH 93 would be addressed during design and construction.
- Appropriate seismic analysis should be conducted, including deterministic and probabilistic methods, as part of design at the reservoir sites. A seismograph would be utilized to monitor the blasting operations at the dam site to ensure that acceleration thresholds are not exceeded.

Soils

With any dam raise alternative, Denver Water would implement environmental protection measures at Gross Reservoir, including an erosion and sediment control plan for social trails and roads.

Plans to prevent water and wind erosion during construction are required by the State of Colorado. The CDPHE Water Quality Control Division (WQCD) would require a stormwater discharge and the Air Pollution Control Division would require a fugitive dust control plan. These plans would incorporate BMPs to prevent soil losses during construction. Methods may include controlling surface water flows and installation of sediment barriers such as fences of straw bales or erosion control fabric. Erosion controls would be inspected regularly during construction, especially where construction is active and after precipitation. These controls would be installed prior to soil disturbance.

As discussed in Section 5.6.7 of the FEIS, the Leyden Gulch Reservoir site contains some abandoned utility poles that may be coated with creosote. Poles located in the proposed reservoir inundation area would be removed along with any stained soil prior to construction activities. Similarly, the South Platte River Facilities study area may contain localized areas of soil contamination associated with construction dumpsites. If either Alternative 8a or 13a is implemented, soils suspected of contamination would be sampled and tested prior to construction activities.

Vegetation

The following measures would be employed to minimize adverse impacts to vegetation, erosion, and the colonization of noxious weeds in disturbed areas.

- A revegetation plan would be developed prior to construction for all areas that would be temporarily disturbed during construction of the Moffat Project. The plan would be in compliance with the Arapaho & Roosevelt National Forests (ARNF) revegetation policy for lands administered by the USFS. In order to increase the likelihood of successful revegetation, the plan should address the selection of site-appropriate species, including native herbaceous and/or woody species, soil preparation, seeding rates and methods, planting of shrubs, mulching and soil amendments, watering frequency and duration (if needed), and monitoring of reestablishment. With the potential for noxious weeds, seed rates should be high to load the seed bank in the soil. Forb species would be included in the seed mixes to provide more food sources for wildlife and to improve the natural environment. Seed mixes would be developed in coordination with the USFS. In addition, Colorado Parks and Wildlife (CPW) (previously called Colorado Division of Wildlife), should be consulted during the preparation of seed mixes to ensure that desirable native species are used. Plantings of cottonwood, willows, currant, and snowberry would also be considered.
- All temporary impact areas would be reseeded and/or planted promptly after construction completion. If these areas have been compacted by equipment and construction activities, the soil would be ripped and tilled prior to seeding to improve water infiltration. Erosion matting, straw, soil amendments or other measures may need to be maximized revegetation success, especially in highly disturbed areas exposed to wind. If matting is used, it should be a product made of biodegradable material, with a single layer to avoid trapping wildlife, such as coconut-straw erosion blankets. Use of soil amendments and fertilizers would be reviewed with the USFS to ensure that they would not favor noxious weeds at the expense of desired vegetation, and that they would not adversely affect riparian areas or water quality.
- The removal of trees in temporary disturbance areas would be avoided whenever possible to maintain structural diversity and to provide necessary shade for preventing the invasion of noxious weeds. Woody debris resulting from vegetation clearing would be utilized on site to the extent practical.
- Construction areas would be fenced or marked to confine construction activities to prevent unnecessary disturbance to soil and native plant communities.
- A weed management plan would be prepared to control noxious weeds and to prevent degradation of habitats. The weed plan should identify the primary species of concern, potential method of spread, proposed methods of control, and monitoring of weed conditions. It would be developed in coordination with the existing FERC-required weed management plan, the USFS, and various county weed coordinators and implemented as part of construction and regular reservoir operations.
- All equipment used in the Project area must be weed-free. All equipment would be cleaned prior to entering the site in order to remove soil and plant parts that may contain weed seeds. Only certified weed-free mulch and bales would be used. All forage products used on USFS lands would comply with USFS Rocky Mountain Region Order No. 02-2005-01 requiring use of certified weed-free hay, straw, or mulch in all activities on National Forest lands.
- All seed used would be free of noxious weeds. Any seed used on USFS land would be required to be tested for smooth brome and "all states noxious weed exam" according to Official Seed

Analysts standards and will be certified by a Registered Seed Technologist or Seed Analysts as meeting the requirements of the Federal Seed Act and the Rules and Regulations for the Colorado Seed Act. The USFS has requested the following language, or equivalent language as approved by the USFS, to be included in contract specifications for revegetation: "Seed mixes will be approved by FERC and the USFS. If a species in the seed mix is not available, the Contractor shall provide written evidence from three seed vendors that the species is not available. With written approval, the mix may be adjusted and the new species may be substituted after consultation with the FERC and the USFS. Seed lot tags shall be available to FERC and the USFS at least one month prior to seeding, for testing that may be performed by USFS. If noxious weeds or smooth brome seeds are found, seed may be rejected and the Contractor shall be responsible for the replacement cost of seed."

- Denver Water would coordinate with the USFS to ensure appropriate reclamation of the Gross Reservoir quarry site and any alternative quarry sites.
- Clearing of trees at Gross Reservoir would need to be conducted in a manner that does not lead to additional spread of mountain pine beetle. Methods to avoid and minimize impacts may include surveys to identify beetle activity prior to timber clearing, and storage and processing of forest residue in a manner that would limit dispersal of beetles. Most of the areas of tree removal are on USFS land and Denver Water would consult with the USFS regarding appropriate removal methods and timing.
- Native topsoil would be salvaged and replaced as part of construction techniques to the extent feasible. Topsoil would be salvaged from areas of temporary disturbance and permanent impacts at the construction sites and would be reused in order to enhance revegetation efforts. Topsoil would not be salvaged from areas infested with noxious weeds. During pipeline construction, where not in existing roadways, topsoil would be salvaged from the trench area and from the subsoil spoil area, stockpiled along the right-of-way (ROW), and respread over the disturbed area. Special topsoil handling protocols would be developed and used to minimize loss, degradation, and mixing with subsoil. Fertilizer would not be used in seeded areas if it would enhance the growth of noxious weeds at the expense of desired vegetation.
- For Alternative 13a, lands affected by agricultural water rights transfer should be seeded with grasses to limit expansion of noxious weeds, where the transfer would result in cessation of agricultural activity or prolonged fallow periods.

Wetlands and Riparian Areas

To minimize adverse impacts to wetlands and other water features from sedimentation and erosion of wetlands and other water features during construction:

- Vehicle operation would be limited to designated construction areas, and the limits of the construction area would be fenced where they are adjacent to sensitive habitats including prairie dog towns, riparian areas, wetlands, and upland trees and shrubs.
- BMPs would be implemented during all phases of construction to reduce impacts from sedimentation and erosion, including the use of berms, brush barriers, check dams, erosion control blankets, filter strips, sandbag barriers, sediment basins, silt fences, straw-bale barriers, surface roughening, and/or diversion channels.
- When practicable, construction in waterways would be performed during low-flow or dry periods.
- Flowing water would be diverted around active construction areas.

- No fill material would be stored in wetlands or other water features.
- No unpermitted discharges would be allowed.
- Prior to construction, orange temporary fence and sediment control measures would be placed to protect existing wetlands that are located outside the planned area of disturbance.
- Wetland areas designated as temporary disturbance that would be used for construction access would be covered with geotextile, straw, and soil prior to use.
- The location and design of stormwater ponds would be coordinated with the Project biologist.

In its FWMP, Denver Water also committed to purchasing credits in a wetland mitigation bank to offset wetland impacts around Gross Reservoir and to replant riparian vegetation around the shoreline of Gross Reservoir.

Wildlife Habitat

- During construction, vehicle operation would be limited to designated construction areas, and the limits of the construction area would be fenced where they are adjacent to sensitive habitats including prairie dog towns, riparian areas, wetlands, and upland trees and shrubs.
- Silt fencing, erosion logs, temporary berms, and other BMPs would be used to prevent degradation of habitats adjacent to the construction area by transport of eroded sediment.
- Temporarily disturbed areas would be seeded with an appropriate mixture of native grasses and forbs; shrubs would be planted where appropriate.
- Open cut streams would be restored equal to or better than pre-construction conditions. To control erosion, bioengineering or the use of plants to control erosion would be preferred instead of riprap or other unnatural bank stabilization techniques. Banks would be planted with native plant species.

Raptors

- If practicable, trees in the construction footprint would be cleared prior to March 1 or after July 31 to prevent raptors (and other birds) from nesting on site and avoid take of or disturbance to active nests during the breeding season. If construction begins after March 1 or prior to July 31, nest surveys would be conducted prior to construction to ensure that no active nests are present in or near the construction footprint.
- Surveys would be conducted annually during an appropriate season (generally April 1 through June 1) to determine presence of active raptor nests. Surveys may need to be conducted at multiple times to address all species, including owls.
- If an active nest is located, protective buffer zones would be established around active nests during construction to avoid disturbance while nesting. Buffer zones and seasonal restrictions would be based on CPW recommendations (CDOW 2008) and on consultation with CPW.

- Within deciduous riparian woodland, individual trees removed would be replaced as specified by State and Federal wildlife agencies to ensure raptor perch trees are replaced for future use. New trees would be planted near areas that naturally receive adequate water, such as near drainage areas or wetlands.

Migratory Birds

Destruction or disturbance of nests that results in loss of eggs or young is a violation of the Migratory Bird Treaty Act. To comply with the Act, land-clearing activities would be timed to avoid the breeding season (primarily April through August, but differs according to species) to avoid impacts to active bird nests, as described for raptors. If clearing during the breeding season cannot be avoided, compliance would occur by surveys and avoidance of active nests until young are fledged. In the Moffat Project FWMP, which has been approved by the Colorado Wildlife Commission, Denver Water has committed to use of pre-construction surveys to identify active nests in the Project footprint and timing of activities to avoid the breeding season.

Aquatic Biological Resources

All practicable steps have been taken to minimize potential adverse effects to aquatic resources resulting from construction and operation of the Project, such as the Avoidance and Minimization activities and BMPs outlined for Water Quality, Stream Morphology and Sedimentation, Wetlands and Riparian Areas, and Wildlife Habitat. These activities during construction would minimize degradation of habitat for fish and other aquatic organisms and minimize adverse impacts to aquatic biological resources.

In its FWMP, Denver Water committed to provide $750,000 for aquatic habitat restoration in the Fraser and upper Williams Fork rivers and tributaries, and $1.5 million for restoration projects in the North Fork South Platte River. In addition, Denver Water committed to creating an Environmental Pool in the enlarged Gross Reservoir to enhance low flows in South Boulder Creek downstream of Gross Reservoir. Denver Water also committed to constructing new habitat for Colorado River cutthroat trout and greenback cutthroat trout in Grand County. Refer to Appendix M of the Moffat Project FEIS for a copy of the FWMP.

3.2 FACTUAL DETERMINATIONS (230.11)

3.2.1 Cumulative Impacts (230.11[g])

Cumulative impacts (referred to as "total environmental effects" in the FEIS) are the changes in an aquatic ecosystem that are attributable to the collective effect of a number of individual discharges of dredged or fill material. Although the impact of a particular discharge may constitute a minor change in itself, the cumulative effect of numerous separate actions can result in a major impairment of the water resources and interfere with the productivity and water quality of existing aquatic ecosystems. Cumulative effects are discussed in detail in Chapter 4 of the FEIS.

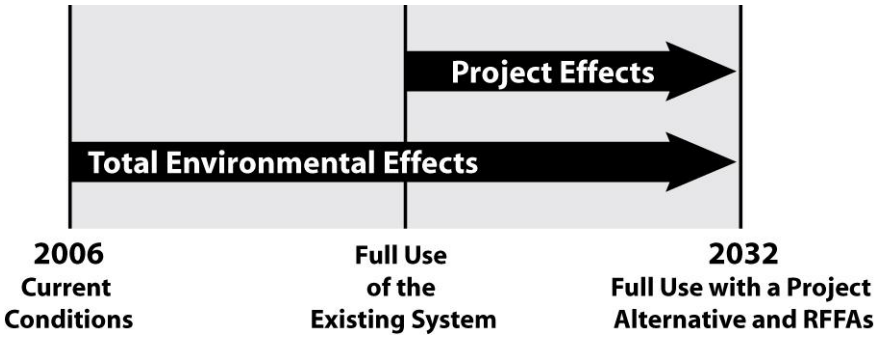
3.2.2 Secondary Effects (230.11[h])

Direct and secondary effects of each of the alternatives are discussed in Section 4 below. A direct effect is a direct result of the Moffat Project, and occurs at the same time and in the same place as the action. A secondary effect is an indirect or subsequent impact of the Project, and occurs later in time or at a distance from the action. The following three impact-related time frame definitions are used for analysis of Moffat Project effects in the FEIS:

- **Current Conditions (2006)** reflects conditions in the year 2006, including demands, facilities, agreements, operations, and administration of the Colorado and South Platte river basins. Under the Current Conditions (2006) scenario, Denver Water's average annual demand is 285,000 AF/yr.
- **Full Use of the Existing System** reflects the operation of Denver Water's existing system and water rights at an average annual demand of 345,000 AF/yr, since this is the point when a Moffat Project is anticipated to come on-line. "Full Use" of the existing system means Denver Water would maximize yield of their existing water supplies using their existing facilities and infrastructure. The Full Use of the Existing System does not include the proposed Moffat Project being considered.
- **Full Use with a Project Alternative and Reasonably Foreseeable Future Actions (RFFAs) (2032)** reflects conditions in Denver Water's system when the Moffat Project is completed and in Full Use in 2032. Under this scenario, Denver Water's demand would be 363,000 AF/yr and the Moffat Project would be providing 18,000 AF/yr of new firm yield.

Both the Full Use of the Existing System and Full Use with a Project Alternative (2032) scenarios include proposed water-related projects that were identified as reasonably foreseeable. The hydrologic effects associated with RFFAs, including Denver Water's growth in demand prior to a Moffat Project coming on-line, are not caused by the Moffat Project. The only difference between the Full Use of the Existing System and Full Use with a Project Alternative and RFFAs (2032) scenario is the inclusion of a Moffat Project alternative, which provides an additional 18,000 AF/yr of new firm yield. Therefore, the comparison of these two scenarios isolates the hydrologic effects that are attributable to a Moffat Project alternative.

The following graphic represents the timelines by which impacts associated with each Moffat Project alternative are evaluated.



Impact thresholds are defined in the Moffat Project FEIS as changes in intensity in terms of the degree, level, or strength of an impact. The following thresholds are used to determine the change in intensity of impacts resulting from a Project alternative:

- *No impact:* no discernable effect
- *Negligible:* effect is at the lowest level of detection and causes very little or no disturbance
- *Minor:* effect that is slight, but detectable, with some perceptible effects of disturbance
- *Moderate:* effect is readily apparent and has measurable effects of disturbance
- *Major:* effect is readily apparent and has substantial effects of disturbance

An assessment of impact thresholds has been provided for all resources except surface water (Section 5.1 of the FEIS) since the degree of impact is specific to each flow-related resource.

4. (SUBPART C) PHYSICAL AND CHEMICAL CHARACTERISTICS

4.1 SUBSTRATE (230.20)

The substrate of the aquatic ecosystem underlies open waters of the U.S. and constitutes the surface of wetlands. It consists of organic and inorganic solid materials and includes water and other liquids or gases that fill the spaces between solid particles (40 CFR 230.20[a]).

The discharge of dredge or fill material can result in varying degrees of change in the complex physical, chemical, and biological characteristics of the substrate. Discharges that alter substrate elevation or contours can result in changes in water circulation, depth, current pattern, water fluctuation, and water temperature.

Discharges may adversely affect bottom-dwelling organisms at the site by smothering immobile forms or forcing mobile forms to migrate. Benthic forms present prior to a discharge are unlikely to recolonize on the discharged material if it is very dissimilar from that of the discharge site.

Erosion, slumping, or lateral displacement of surrounding bottom of such deposits can adversely affect areas of the substrate outside the perimeters of the disposal site by changing or destroying habitat. The bulk and composition of the discharged material and the location, method, and timing of discharges may all influence the degree of impact on the substrate (40 CFR 230.20[b]).

Section 5.11 of the Moffat Project FEIS contains detailed information about effects to aquatic resources as a result of implementing a Project alternative.

4.1.1 No Action Alternative

Since no ground disturbing activities would occur under the No Action Alternative, no substrate under wetlands or other waters would be directly affected.

4.1.2 Proposed Action

Construction of the Proposed Action would involve permanent discharge of fill in about 1.95 acres of substrate under wetlands in the Gross Reservoir study area. The majority of the impacts would be associated with the reservoir enlargement from inundation at creek and gulch inlets (South Boulder Creek, Winiger Gulch, an unnamed creek, and Forsythe Gulch), and shoreline wetlands. Wetland impacts would also result from dam and spillway expansion. Fill would be permanently discharged into about 3.53 acres of substrate under other waters of the U.S. Impacts to substrate under other waters of the U.S. would occur as a result of the expansion of Gross Reservoir, and would include Forsythe Gulch, South Boulder Creek, an unnamed tributary, Winiger Gulch, and an unnamed tributary to Winiger Gulch. Total direct and indirect effects to the substrate under wetlands and other waters would be 5.48 acres.

4.1.3 Alternative 1c

Construction of Alternative 1c would involve discharge of fill in wetlands at Gross Reservoir and the Leyden Gulch Reservoir site. At Gross Reservoir, impacts would be similar to the Proposed Action and impact 1.6 acres of wetlands. At the Leyden Gulch Reservoir, 4.55 acres of permanent wetland impacts would occur as a result of dam construction and inundation of wetlands along Leyden Gulch, tributaries to Leyden Gulch, and hillside seeps and realignment of SH 93. Total

direct and indirect effects to the substrate under wetlands and other waters for Alternative 1c would be 9.27 acres.

4.1.4 Alternative 8a

Under Alternative 8a, direct impacts to about 1.77 acres of wetlands would occur. Most of the impacts would occur at Gross Reservoir, and would be similar to the impacts described under the Proposed Action. A small area of direct impacts to wetlands would occur at the South Platte River Facilities. Direct impacts to about 3.20 acres of other waters would occur at Gross Reservoir, and would be similar to the impacts that would occur under the Proposed Action. The total impacts to substrate under wetlands and other waters for Alternative 8a would be 4.97 acres.

4.1.5 Alternative 10a

Under Alternative 10a, about 1.75 acres of direct wetland impacts would occur. Most of the impacts would occur at Gross Reservoir, and would be similar to the impacts described under the Proposed Action. Direct impacts to about 3.16 acres of other waters would occur at Gross Reservoir, and would be similar to the impacts that would occur under the Proposed Action. The total impacts to substrate under wetlands and other waters for Alternative 10a would be 4.91 acres.

4.1.6 Alternative 13a

Under Alternative 13a, impacts to about 83.87 acres of wetlands and 11.4 acres of other waters would occur. Most of the wetland and other waters impacts would occur as a result of dry up of irrigated farmland, resulting from transfer of agricultural water rights. Direct impacts to about 11.4 acres of other waters would occur. Most of these impacts would result from dry up of agricultural land associated with transfer of agricultural water rights. Impacts at Gross Reservoir and the South Platte River Facilities would be similar to those described under Alternative 8a. The total impacts to substrate under wetlands and other waters for Alternative 13a are 95.27 acres.

4.2 SUSPENDED PARTICULATE MATERIALS/TURBIDITY (230.21)

Suspended particulates in the aquatic ecosystem consist of fine-grained mineral particles (usually smaller than silt) and organic particles. Suspended particulates may enter water bodies as a result of land runoff, flooding, vegetative and planktonic breakdown, resuspension of bottom sediments, and human activities including dredging and filling. Particulates may remain suspended in the water column for variable lengths of time from factors such as agitation of the water mass, particulate specific gravity, particle shape, and physical and chemical properties of particle surfaces (40 CFR 230.21[a]). Section 5.1 of the Moffat Project FEIS contains detailed information about effects to water flows.

The discharge of dredge or fill material can result in greatly elevated levels of suspended particulates in the water column for varying lengths of time. These new levels may reduce light penetration and lower the rate of photosynthesis and the primary productivity of an aquatic area if they last long enough. Sight dependent species may suffer reduced feeding ability leading to limited growth and lowered resistance to disease if high levels of suspended particulates persist. The biological and the chemical content of the suspended material may react with DO in the water, which can result in oxygen depletion. Toxic metals and organics, pathogens, and viruses absorbed or adsorbed to fine-grained particulates in the material may become biologically available to organisms either in the water column or on the substrate. Significant increases in suspended particulate levels create turbid plumes that are highly visible and aesthetically displeasing. The extent and persistence of these adverse impacts caused by discharges depend upon the relative

increase in suspended particulates above the amounts occurring naturally; the duration of the higher levels; the current patterns, water level, and fluctuations present when such discharges occur; the volume, rate, and duration of the discharge; particulate deposition; and the seasonal timing of the discharge (40 CFR 230.21[b]).

4.2.1 Suspended Sediment Effects Common to All Alternatives

Suspended sediment concentrations are generally highest at high flows. Under all action alternatives, flows are generally predicted to decrease in West Slope streams and increase in the North Fork South Platte River and South Boulder Creek. It is therefore anticipated that suspended sediment loads would be reduced in West Slope streams and increased in streams carrying additional diverted water.

4.3 WATER (230.22)

Water is the part of the aquatic ecosystem in which organic and inorganic constituents are dissolved and suspended. Water constitutes part of the liquid phase and is contained by the substrate. Water forms part of a dynamic aquatic life-supporting system. Water clarity, nutrients and chemical content, physical and biological content, dissolved gas levels, pH, and temperature contribute to its life-sustaining capabilities (40 CFR 230.22[a]).

The discharge of dredge or fill material can change the chemistry and the physical characteristics of the receiving water at a disposal site through the introduction of chemical constituents in suspended or dissolved form.

Changes in the clarity, color, odor, and taste of water and the addition of contaminants can reduce or eliminate the suitability of water bodies for populations of aquatic organisms, and for human consumption, recreation, and aesthetics. The introduction of nutrients or organic material to the water column from the discharge can lead to a high biochemical oxygen demand, which in turn can lead to reduced DO, thereby potentially affecting the survival of many aquatic organisms. Increases in nutrients can favor one group of organisms, such as algae, to the detriment of other more desirable types, such as submerged aquatic vegetation, potentially causing adverse health effects, objectionable tastes and odors, and other problems (40 CFR 230.22[b]). Sections 4.6.2 and 5.2 of the Moffat Project FEIS contains detailed information about effects on water and water quality.

4.3.1 Direct, Indirect, and Secondary Effects to Water

No Action Alternative

There would be no water quality effects under the No Action Alternative to any of the reservoirs in the Project area, except Chatfield Reservoir. Annual deliveries to Chatfield Reservoir would increase more under the No Action Alternative as compared to the action alternatives. Thus, annual loadings of phosphorus to Chatfield Reservoir may increase under the No Action Alternative. Impacts to water quality would be minor.

There would be negligible or no water quality effects to streams under the No Action Alternative except to Ranch Creek and the South Platte River. Ranch Creek in the Fraser River Basin may have minor impacts on temperature due to reduced stream flows. In the South Platte River between the North Fork South Platte River and Chatfield Reservoir, there would be additional phosphorus loadings due to increased annual deliveries through the Roberts Tunnel, resulting in a minor impact. Water Quality below Chatfield Reservoir is not expected to change.

Proposed Action

Under the Proposed Action, there would be a total of about 3.53 acres of direct permanent effects to waters from new facilities and inundation. Of this, about 2.78 acres would occur on South Boulder Creek, and the remaining impacts would occur on Forsythe Gulch, Winiger Gulch tributary, Winiger Gulch, an unnamed tributary, and Chamberlain Gulch.

Indirect effects would occur from changes in stream flow. The following summarizes the major conclusions of the impact analyses of surface water resources in the FEIS. Impacts would be similar for all action alternatives. The following impacts are based on a comparison of Full Use with a Project Alternative (2032) and Full Use of the Existing System.

- For all action alternatives, additional Denver Water diversions would occur in average and wet years and would be highly concentrated during the runoff months primarily in May, June, and July. Typically, additional diversions would be greater in wet years following dry year sequences. On average, additional diversions would be greatest from the Fraser and Williams Fork river basins than from the Blue River Basin, and least from the South Platte River and South Boulder Creek.
- For all action alternatives, there would be no additional diversions attributable to the Moffat Project in dry years because Denver Water would divert the maximum amount physically and legally available under their existing water rights without additional storage in their system.
- For all action alternatives, changes in stream flow would be greatest in average and wet years during the runoff months, which coincide with the period that Denver Water's additional diversions would be greatest.
- On the West Slope, flows would decrease on average due primarily to Denver Water's additional diversions. On the East Slope, there would be both flow increases and decreases due primarily to the combined impacts of Denver Water's additional diversions, a shift in seasonal operations between Denver Water's North (Moffat) and South (Foothills and Marston) WTPs, additional effluent returns at the Bi-City WWTP and Metro WWTP, and additional return flows accruing to the river due to Denver Water's outdoor water usage. Changes in stream flow in each affected river basin are generally described below:
- Flows in the Fraser and Williams Fork river basins would decrease in average and wet years during the runoff months due to Denver Water's additional diversions. In some wet years following a drought, flows below Denver Water's diversion points would be more consistent with a dry year or below average years due to additional diversions under the Proposed Action. The reduction in flows in the year following the drought would increase the frequency and duration of dry year conditions. Denver Water's additional diversions under the Proposed Action would also affect the magnitude, timing, frequency, and duration of peak flows below their diversion points. At the locations evaluated in the Fraser River Basin, the magnitude of small flood peak flows would decrease up to 10%. There would be little change in the timing and magnitude of peak flows for large floods in both the Fraser and Williams Fork river basins. There would be a significant decrease in the duration of both small and large floods particularly along tributaries to the Fraser River and Williams Fork River.
- Flows in the Blue River Basin would decrease in average and wet years during summer months and increase slightly during winter months due to differences in Roberts Tunnel diversions and spills at Dillon Reservoir. Flow changes in the Blue River Basin would be driven primarily by the seasonal shift in WTP operations. Under all action alternatives there would be a reduction in winter operations of Foothills and Marston WTPs because the Moffat WTP would operate at a minimum level during the winter.

- Flows along the Colorado River would decrease in average and wet years during the runoff months due to changes in surface water flows in the Fraser, Williams Fork, and Blue river basins which would be translated downstream and into the Colorado River.
- Flows in South Boulder Creek upstream of Gross Reservoir would increase in average and wet years during the runoff months due to Denver Water's additional diversions through the Moffat Tunnel. While flows would increase on average, there would be no change in the maximum flows experienced in this reach because the capacity of South Boulder Creek above Gross Reservoir is limited to approximately 1,200 cubic feet per second (cfs). During high runoff, Denver Water must limit Moffat Tunnel deliveries in order to meet this constraint. From Gross Reservoir to the South Boulder Canal Diversion structure, changes in flow reflect Gross Reservoir operations. In general, flows would be higher during winter months as water would be moved out of Gross Reservoir and into Ralston Reservoir in response to the WTP load shift from the Southern WTPs to the Moffat WTP. Increases in outflow from Gross Reservoir would generally be greatest in dry years because Denver Water would typically draw more water from their North System storage as a drought begins. Flows during the summer would be lower on average because Foothills and Marston WTPs would meet a greater portion of the overall demand during these months and as a result, Gross Reservoir releases would decrease. Downstream of the South Boulder Diversion Canal, flows would generally decrease in wet years because Denver Water would divert more native South Boulder Creek water.
- Flows in the North Fork South Platte River would decrease on average during winter months and increase during summer months. While flows would increase on average during summer months, there would be no change in the maximum flows experienced because Denver Water operates their system in a manner to keep the average daily flow in the North Fork South Platte River below 680 cfs at Grant and below 980 cfs above the confluence with the mainstem (Yevdjerick and Simons 1966 and 1967). Flow changes in the North Fork South Platte River would be driven primarily by the load shift in WTP operations. Diversions through the Roberts Tunnel during winter months would be lower on average, which results in equivalent lower flows in the North Fork South Platte River in these months. Summer diversions through Roberts Tunnel would generally be higher, and consequently flows in the North Fork South Platte River would be higher on average from May through September.
- Flow changes along the South Platte River would be relatively minor and vary depending on the location. In general, flows would change due to additional direct diversions and exchanges to Strontia Springs Reservoir and Conduit 20, changes in Moffat WTP operations, and the load shift between Denver Water's northern and southern WTPs. In addition, the demand that would be met with additional storage on-line is higher under the action alternatives; therefore, effluent returns at Bi-City and Metro WWTPs and return flows accruing to the river due to Denver Water's outdoor water usage would increase. As a result, average annual flows would be higher at the South Platte River at Henderson gage.
- The hydrologic impacts of the Proposed Action and Alternative 1c would be similar. The water source for Alternative 1c would be the same as the Proposed Action, except that a portion of the additional Moffat Collection System diversions would be stored in a new Leyden Gulch Reservoir.
- Hydrologic impacts of Alternatives 8a, 10a, and 13a would be slightly less on the West Slope and slightly greater on the East Slope compared to the Proposed Action. These alternatives include reusable water (Alternatives 8a and 10a) and transferred agricultural water rights (Alternative 13a) for a portion of the new supply. As a result, diversions from the Moffat Collection System would be slightly lower on average under these alternatives. However,

changes in surface water hydrology under these alternatives would still be similar to the Proposed Action because reusable supplies or agricultural supplies would be pumped back to the Moffat Collection System infrequently and only as needed to supplement Denver Water's Moffat supplies during a drought.

- Hydrologic impacts of the No Action Alternative would be less than the action alternatives in the Fraser and Williams Fork river basins and greater in the Blue River Basin. Under the No Action Alternative, Roberts Tunnel diversions would increase substantially compared to the action alternatives because Denver Water would rely more heavily on their Blue River supplies and Strategic Water Reserve to meet a higher demand, particularly during droughts. Increases in Moffat Tunnel and Gumlick Tunnel diversions under the No Action Alternative would be substantially less than increases under the action alternatives. Flows in South Boulder Creek above and below Gross Reservoir would be less on average than the action alternatives due primarily to differences in Moffat Tunnel diversions and storage at Gross Reservoir. Flows in the North Fork South Platte River would increase on average compared to the action alternatives due to additional Robert Tunnel imports from the Blue River Basin. Flows along the South Platte River would generally be slightly less under the No Action Alternative than the action alternatives because Denver Water would rely more heavily on their South Platte supplies and Strategic Water Reserve to meet a higher demand.
- The No Action Alternative would result in shortages in meeting customer demands for both treated and raw water deliveries, would require use of the Strategic Water Reserve, would cause Gross Reservoir to frequently be at the minimum pool level, and would prohibit the ability to use the Moffat WTP about half of every year. These impacts apply to using the Strategic Water Reserve and may be less if restrictions are also imposed (Combination Strategy).

Alternative 1c

Under Alternative 1c, a total of about 3.12 acres of waters would be directly and permanently affected by new facilities and inundation. This includes about 2.36 acres of impacts to South Boulder Creek, and the remaining impacts would occur on Forsythe Gulch, Winiger Gulch tributary, Winiger Gulch, an unnamed tributary, and Chamberlain Gulch.

Alternative 8a

Under Alternative 8a, direct permanent impacts would occur to about 3.20 acres of waters from new facilities and inundation. Most of these impacts would occur on South Boulder Creek (2.59 acres), and the remaining impacts would occur on Forsythe Gulch, Winiger Gulch tributary, Winiger Gulch, an unnamed tributary, and Chamberlain Gulch.

Alternative 10a

Under Alternative 10a, a total of about 3.16 acres of waters would be directly and permanently affected by placement of facilities and inundation. This includes about 2.59 acres of impacts to South Boulder Creek, and the remaining impacts would occur on Forsythe Gulch, Winiger Gulch tributary, Winiger Gulch, an unnamed tributary, and Chamberlain Gulch.

Alternative 13a

Under Alternative 13a, a total of about 11.40 acres of waters would be directly and permanently affected by new facilities and inundation. This includes about 8 acres of impacts to irrigation ditches and ponds that would be affected by the transfer of agricultural water rights. The remaining

impacts would occur on South Boulder Creek, Forsythe Gulch, Winiger Gulch tributary, Winiger Gulch, an unnamed tributary, Chamberlain Gulch, and the South Platte River.

4.3.2 Water Quality Effects Common to All Action Alternatives

Effects to water quality are discussed in Section 5.2 of the Moffat Project FEIS. Water quality effects for the Proposed Action and common to the action alternatives are discussed in this section.

Reservoirs

Williams Fork Reservoir

Water quality within Williams Fork Reservoir is dependent on upstream water quality from the Williams Fork River, and/or changes in reservoir operation, evaporation, and water surface elevation. Williams Fork Reservoir water quality is not expected to change as a result of any actions taken by Denver Water under any alternative. The anticipated reduction in water surface elevation and reservoir storage are minor and should not affect water quality.

Dillon Reservoir

Water quality within Dillon Reservoir is dependent on the upstream water quality from the Blue River, and changes in reservoir operation, evaporation, and water surface elevation. Water quality of the Blue River inflow or tributary inflow to Dillon Reservoir is not expected to change as a result of any actions taken by Denver Water under any alternative. The anticipated increase and decrease in reservoir water surface elevation of approximately 3 feet is not expected to significantly affect water quality.

Wolford Mountain Reservoir

Water quality within Wolford Mountain Reservoir is dependent on the upstream water quality from Muddy Creek, and/or changes in reservoir operation, evaporation, and water surface elevation. Muddy Creek water quality is not expected to change as a result of any actions taken by Denver Water under any alternative. The reservoir would experience very few and small differences in water surface elevation and content. Therefore, water quality in Wolford Mountain Reservoir is not expected to change.

Grand Lake, Shadow Mountain Reservoir, and Granby Reservoir (The Three Lakes)

To evaluate potential impacts on the Three Lakes, the Three Lakes Water-Quality Model (AMEC 2008) was applied. For all three water bodies, Project-related changes in average nutrients, chlorophyll *a*, DO, TSS, water clarity and peak chlorophyll *a* would be less than 2% for dry, wet, and average years. As such, the modeling results indicate no impact or a negligible impact to Grand Lake, Shadow Mountain Reservoir, and Granby Reservoir from the Proposed Action, as compared to Full Use of the Existing System. Shadow Mountain Reservoir is listed on the Section 303(d) List for DO. The modeling results indicate no change in DO for Shadow Mountain Reservoir (for the simulated full depth). Additionally, the modeling results indicate that only minimum DO at the bottom of Granby Reservoir (which affects Shadow Mountain Reservoir through Farr pumping) would only decrease by 0% to 1%. Based on this, changes to DO in Shadow Mountain Reservoir under Full Use with a Project Alternative (2032) compared to Full Use of the Existing System would be negligible.

Granby Reservoir is listed on the Section 303(d) List for Aquatic Life Use due to mercury identified in fish tissue. Rates of mercury methylation in lakes and reservoirs have been tied to DO concentrations. Low DO can enhance methylation in the sediments, MeHg fluxes from the sediment and methylation in the water column. Model results indicate that a 0% to 1% (depending

on year type) decrease in annual minimum DO at the bottom of Granby Reservoir would occur under the Proposed Action as compared to Full Use of the Existing System. Based on this small anticipated difference, effects on mercury methylation would be expected to be negligible. Additionally, it is possible that small predicted increases in nutrients (less than or equal to 2%) could result in slightly higher biomass, which could lead to slight reductions in MeHg concentrations. Results from recent studies conducted in Colorado indicate that increases in nutrients can result in reductions in mercury concentrations in biota (Lepak 2013), as discussed in Section 4.6.2.1.1 of the FEIS. This effect would further support the prediction of negligible net impacts to mercury in fish tissue.

Gross Reservoir

Short-term changes to reservoir water quality are anticipated due to inundation of new areas with expansion of the reservoir for the Proposed Action. These include minor increases in organic carbon concentrations and minor to moderate increases in mercury concentrations in fish tissue. This is relevant because Gross Reservoir is currently on the Monitoring and Evaluation List for mercury concentrations in fish tissue (CDPHE 2012). The duration of these short-term effects is uncertain. No long-term adverse effects to Gross Reservoir water quality, including trophic state, are anticipated for the Proposed Action or other action alternatives.

Antero Reservoir

Water quality within Antero Reservoir is dependent on upstream water quality from the South Platte River, and/or changes in reservoir operation, evaporation, and water surface elevation. The South Platte River water quality upstream of Antero Reservoir is not expected to change as a result of any actions taken by Denver Water under any alternative. The reservoir would experience little to no change in water surface elevation and content. Therefore, water quality in Antero Reservoir is not expected to change.

Eleven Mile Canyon Reservoir

Water quality within Eleven Mile Canyon Reservoir is dependent on the upstream water quality from the South Platte River, and/or changes in reservoir operation, evaporation, and water surface elevation. The South Platte River water quality is not expected to change as a result of any actions taken by Denver Water under any alternative. The reservoir would experience little to no change in water surface elevation and content. Therefore, water quality in the Eleven Mile Canyon Reservoir is not expected to change due to the action alternatives.

Cheesman Reservoir

Water quality within Cheesman Reservoir is dependent on the upstream water quality from the South Platte River, and/or changes in reservoir operation, evaporation, and water surface elevation. The South Platte River water quality is not expected to change as a result of any actions taken by Denver Water under any alternative. The reservoir is expected to have an average decrease in surface elevation up to 3 feet in average and dry years; however, water quality in Cheesman Reservoir is not expected to change due to the Action alternatives.

Strontia Springs and Chatfield Reservoirs

Water quality within both reservoirs is dependent on upstream water quality from the South Platte River, water deliveries through the Roberts Tunnel, and/or changes in reservoir operation, evaporation, and water surface elevation. South Platte River water quality changes are possible for copper, iron, and nickel. These changes in upstream water quality occur on a seasonal basis with yearly loading remaining similar. Thus, some changes on a seasonal basis may occur in both

reservoirs, but changes on an annual basis with regard to loading and impacts to the hypolimnion are not expected.

In Chatfield Reservoir, on an annual basis, the total phosphorus loadings from the South Platte River are not expected to change. The seasonal loading of phosphorus may vary due to seasonal changes in deliveries through Roberts Tunnel.

Both reservoirs would operate within the same general water surface elevation range; therefore, water quality changes are not expected from any operational changes associated with the action alternatives.

Stream Segments

Evaluation of potential water quality changes due to each alternative was performed for each affected basin. Due to the size of the study area, criteria were developed to identify the segments with the greatest potential for water quality changes. The following criteria were used:

- Those segments identified in Chapter 3 of the Moffat Project FEIS with ambient conditions (typically 15^{th} or 85^{th} percentile) exceeding numeric water quality standards as delineated in CDPHE Regulations.
- Those segments listed on the 303(d) List, the Monitoring and Evaluation List, or having a Total Maximum Daily Load (TMDL) (CDPHE 2006).
- Those segments with the PACSM flow increasing or decreasing by 15% or more in wet, dry and/or average years.

The third criterion is based on the CDPHE WQCD Antidegradation Significance Determination for New or Increased Water Quality Impacts Procedural Guidance (2001). Per the guidance document: "In order to be 'insignificant', the new or increased discharge may not increase the actual instream concentration by more than 15% of the available increment over the baseline." This definition considers changes in concentration; however, it is unlikely that a change in stream flow less than 15% would result in a change in concentration more than 15% for stream segments with ambient conditions well within water quality standards. Therefore, the 15% flow-change threshold was a criteria used to identify stream segments for evaluation that were not identified by the other criteria.

Fraser River

The Proposed Action and other action alternatives may have potential water quality impacts in the Fraser River Basin, including changes in concentrations of constituents potentially exceeding stream standards (copper, iron, lead, pH, and Aquatic Life Use).

There are six minor and major wastewater treatment facilities in the Fraser River Basin watershed, including the Fraser Sanitation District, Winter Park Water and Sanitation District, and Granby Wastewater Treatment Facility. There are four water providers that use either surface water and/or groundwater under the influence of surface water in the Fraser River Basin watershed: Town of Granby, Grand County Water No. 1, Winter Park Water and Sanitation District, and the YMCA Snow Mountain Ranch. The flow in the Fraser River is influenced by diversions in the headwaters (including the Moffat Tunnel) and deliveries through the Gumlick and Vasquez tunnels into Vasquez Creek.

The action alternatives would result in similar changes in flow throughout the Fraser River Basin, including Vasquez Creek, St. Louis Creek, and Ranch Creek. A change in flow, by itself, does not indicate a change in water quality because the concentrations of the constituents are contained in the

diverted water, and are the same concentrations as those remaining in the stream water. The following types of potential changes in water quality were evaluated:

Changes in Concentrations of Constituents Potentially Exceeding Stream Standards (Copper, Iron, Lead, pH, and Aquatic Life Use)

The Fraser River is listed on the Monitoring and Evaluation List for copper from the Town of Fraser to the confluence of the Colorado River, and for lead from the Town of Tabernash to the Town of Granby (CDPHE 2012). As indicated in Table 3.2-5 of the FEIS, one monitoring station indicates an 85th percentile value for copper greater than the stream standard at the Town of Fraser. Additionally, two CDPHE stations and four U.S. Geological Survey (USGS) stations have records on copper concentrations beginning in 2000. There have been two exceedances of the acute standard for copper on the Fraser River which occurred on January 25, 2006 and May 5, 2010 at WQCD station 12166 (Hranac 2013). As discussed in Section 4.6.2 of the FEIS, it is not anticipated that Full Use with a Project Alternative (2032) would cause or contribute to stream standard exceedances for copper or lead.

The mainstem of the Fraser River and Vasquez Creek are also provisionally listed on the Section 303(d) List for Aquatic Life Use (CDPHE 2012). A discussion of the impacts related to Aquatic Life Use is presented in Section 5.2 of this document.

Potential Changes in Water Temperature

The Fraser River and Ranch Creek are both listed on 303(d) List for temperature, but St. Louis Creek is not listed. All three would be subject to potential increases in frequency of temperature standard exceedances under the Proposed Action and other action alternatives.

Fraser River: For Sections 10b and 10c of the Fraser River, flow changes resulting only from the Proposed Action are not anticipated to cause increased frequency of stream temperature standard exceedances. Sections 10b and 10c would experience negligible impacts under the Proposed Action.

For the data sets available to support a single-variable regression analysis, stream flow in isolation from other factors known to affect water temperature could not be reliably used as a predictor of water temperature changes in these river sections. During the period of concern for potential exceedances to stream temperature standards, mid-July through August, no further impact attributable to the Proposed Action was identified. Although flow is not a good predictor of water temperature for the data available for these river sections, the number of days with low flows (i.e., days in which the modeled flow was less than 100 cfs), would not change between Full Use of the Existing System and Full Use with a Project Alternative (2032). This indicates that the Proposed Action is not anticipated to have any additional effect on stream temperature beyond the effects of Full Use of the Existing System. However, based on the historical record of daily maximum and maximum weekly average temperature exceedances in the Fraser River Basin, it is possible that such exceedances could occur in the future during periods when diversions related to the Proposed Action would be taking place.

Ranch Creek: Changes in flow resulting only from the Proposed Action are not expected to cause increased frequency of stream temperature standard exceedances. Negligible impacts are anticipated under the Proposed Action.

For the data sets available to support a single-variable regression analysis, stream flow in isolation from other factors known to affect water temperature could not be reliably used as a predictor of water temperature changes in these river sections. During the period of concern for potential exceedances to stream temperature standards, mid-July through August, no further impact

attributable to the Proposed Action was identified. Although flow is not a good predictor of water temperature for the data available for this stream reach, the number of days with low flows (days in which the modeled flow was less than 6 cfs), would not change between Full Use of the Existing System and Full Use with a Project Alternative (2032). This indicates that the Proposed Action is not anticipated to have any additional effect on stream temperature beyond the effects of Full Use of the Existing System.

St. Louis Creek*:* St. Louis Creek is not believed to be at risk for temperature exceeding regulatory standards, and the Proposed Action and other action alternatives would have no effect on compliance with stream temperature standards.

Permit Compliance for Moffat Tunnel Discharges

An issue with the Moffat Tunnel discharge is the potential for decreased dilution of the permitted discharge resulting in increases in contaminant concentrations to harmful levels. There are no projected impacts with regard to the Moffat Tunnel permitted discharge attributable to the Proposed Action or other action alternatives.

Potential Changes in Nutrient Levels

Modeled average annual total nitrogen and total phosphorus concentrations would increase 4% or less at Ranch Creek, Fraser River below the Fraser WWTP, and the mouth of the Fraser River. This analysis indicates that Full Use with a Project Alternative (2032) would have minor to negligible impacts on nutrient concentrations in the Fraser River Basin as compared to Full Use of the Existing System.

Potential Impacts to WWTP Dischargers

Concerns of WWTP dischargers are the potential for more stringent discharge permits and costly plant upgrades resulting from stream flow changes or water quality changes in the receiving water. Projected impacts on WWTP permitted discharges are not attributable to the Proposed Action or other action alternatives.

Effects on Vasquez Creek Caused by Increased Flows through the Gumlick Tunnel

No impacts to water quality in Vasquez Creek are anticipated as a result of the Proposed Action and other action alternatives.

Williams Fork River

There is one discharge permit in the Williams Fork River watershed per EPA's Envirofacts website: for the Climax Molybdenum Company, with discharge to the Williams Fork River/Ute Creek. The permitted flow is not listed in the EPA's Permit Compliance System database. Denver Water is the only public water system with facilities in the Williams Fork River watershed.

There are four tributaries from which Denver Water diverts water through the Gumlick and Vasquez tunnels: Steelman Creek, Jones Creek, Bobtail Creek, and McQueary Creek. Further downstream, the PACSM results do not indicate significant changes in flow. There was very little data available from public sources (Storage and Retrieval EPA Database [STORET] and USGS websites) for any location on the Williams Fork River. Denver Water has maintained water quality sampling in the Williams Fork Basin and provided data on each of the above tributaries as well as on the mainstem.

Assimilation Capacity for Climax Mine Discharges

There are no projected changes in water quality in the Williams Fork River due to influences from the Climax Mine discharge or from changes in flow. Additionally, there are no expected impacts to

the Climax Mine discharge permit due to projected changes in flow in the Williams Fork River under the Proposed Action or other action alternatives.

Effects Due to Changes in Tributary Flows and Water Quality

Change in flow from each tributary has the potential to change water quality in the Williams Fork River. However, water quality is not anticipated to change with regard to the Proposed Action or other action alternatives since all parameters would be well below stream standards except dissolved copper and DO. Further analysis showed that copper concentrations would not likely exceed the stream standards due to changes in flow. Effects related to DO levels downstream of Williams Fork Reservoir are further discussed in the following section.

Potential Effects on Dissolved Oxygen and Temperature Due to Changes in Reservoir Releases

Minimal water quality impacts would occur downstream of Williams Fork Reservoir as a result of the Proposed Action or other action alternatives. Projected flows would be within 8% of one another for all modeled time periods. Thus, no significant water quality changes are anticipated downstream of Williams Fork Reservoir resulting from the Proposed Action or other action alternatives.

Potential Effects on WWTPs or Water Treatment Providers

There are no anticipated changes to wastewater treatment providers and no expected impacts to water providers downstream.

Colorado River

There is one WWTP in this segment, the Kremmling Sanitation District Plant which is permitted for 0.3 mgd discharged to Muddy Creek. There are four water suppliers that use surface water or groundwater under the influence of surface water in this segment: the Town of Hot Sulphur Springs, the Town of Kremmling, the Bar Lazy J Guest Ranch near Parshall, and the Drowsey Water Ranch near Granby.

Potential water quality changes in the Colorado River that could be attributed to the Proposed Action or other action alternatives would occur through the following:

Potential Changes in Water Temperature

Increased frequency of temperature standard exceedances is not anticipated as a result of the Proposed Action. On average, monthly flows under Full Use with a Project Alternative (2032) would be within 6% of Full Use of the Existing System, except in June of average years when they would be within 13%. At Hot Sulphur Springs, for 181 of 2,790 days modeled, flow decreased greater than 10% between Full Use of the Existing System and Full Use with a Project Alternative (2032). At the Kremmling sampling site, flow decreased more than 10% on 284 of 2,790 days modeled. The model evaluated dry years between Full Use of the Existing System and Full Use with a Project Alternative (2032) and found no days where flow changed greater than 10%.

Flows would change very little in July and August, and it is not anticipated that there would be an increased frequency of the temperature standard exceedances. This portion of the Colorado River is listed on the Section 303(d) List, however, it is anticipated that impacts to water quality would occur between Current Conditions (2006) and Full Use with a Project Alternative (2032). Impacts directly associated with the Proposed Action are therefore not anticipated.

Potential Changes in WWTP Discharge Permit and Treated Wastewater Contributions

Potential exists for more stringent discharge permits for WWTPs, necessitating capital expenditures for upgrades. Potential changes in water quality due to changes in treated wastewater contributions also exist.

Potential Effects on Aquatic Life Use

The upper Colorado River from the outlet of Windy Gap Reservoir to the 578 Road Bridge is listed on the Monitoring and Evaluation List for Aquatic Life Use (CDPHE 2012). A discussion of the Aquatic Life Use listing and potential impacts related to the Proposed Action and other action alternatives is presented in Section 5.11 of the FEIS.

Potential Changes to Manganese Concentrations Downstream of 578 Road

Potential changes in manganese concentrations in this area would be the result of changes between Current Conditions (2006) and Full Use of the Existing System. The Proposed Action and other action alternatives are not anticipated to affect manganese concentrations.

Effects on Moffat WTP

The supply to Moffat WTP is not from the Colorado River. The water quality for the plant inflow is not impacted by any changes in the Colorado River.

Muddy Creek

Potential water quality changes under the Proposed Action and other action alternatives are as follows:

Potential Increase in Temperature Standard Exceedances Downstream of Wolford Mountain Reservoir

Temperature in Muddy Creek below Wolford Mountain Dam would be influenced by the reservoir level from which water is released, as the reservoir has four outlet gates at 20-foot intervals in elevation. Wolford Mountain Dam is not operated by Denver Water and there would be no anticipated impact from operational changes of Wolford Mountain as a result of the Proposed Action or other action alternatives.

Potential Impact to WWTP Permits

There are no expected impacts to the Kremmling WWTP permit under the Proposed Action or other action alternatives.

Potential Changes in Water Quality Caused by Changes in Treated Wastewater Volume

The percentages of wastewater flow would be significantly less than the currently permitted conditions and there would be no anticipated impacts to Muddy Creek under the Proposed Action or other action alternatives due to changes in discharge of treated effluent.

Potential Changes in Water Quality Caused by Changes in Releases from Wolford Mountain Reservoir

Water quality changes would potentially occur from changes in Wolford Mountain Reservoir releases due to changes in proportional contributions between the dam and downstream tributaries. With the exception of temperature, changes are likely derived from soils in the Alkali Slough, a tributary to Wolford Mountain Reservoir (Stevens and Sprague 2001). Changes in reservoir releases would therefore not likely change parameter concentrations since the reservoir attenuates spikes in concentrations resulting from snowmelt or storm runoff. There would be no anticipated

impact due to changes in releases from Wolford Mountain Reservoir. Projected changes in quantity and timing of flows are anticipated to be infrequent and minor. Potential water quality impacts in Muddy Creek as a result of the Proposed Action or other action alternatives are therefore not anticipated.

Blue River

The Blue River downstream of Dillon Reservoir is highly influenced by operation and releases from the reservoir. This portion of the Blue River is reviewable, per CDPHE regulations. There is one major WWTP, the Silverthorne Dillon Joint Sewer Authority (JSA), rated at 4.0 mgd, per the EPA's Envirofacts website. There is one minor WWTP, Blue Valley Ranch, with flow less than 0.05 mgd. No drinking water systems utilizing surface water exist along the Blue River between Dillon Reservoir and the confluence with the Colorado River. The Town of Silverthorne uses wells adjacent to the Blue River for potable water supply. These wells are classified as a groundwater source not under the influence of surface water under the Safe Drinking Water Act.

Water quality changes under the Proposed Action or other action alternatives could result from the following:

Potential Changes in Discharge Permits

Potential exists for more stringent discharge permits for WWTPs, necessitating capital expenditures for upgrades. The acute and chronic low flows are estimated to be the same; thus, any changes to the JSA's WWTP discharge permit are not anticipated to be a result of the Proposed Action or other action alternatives.

Potential Changes in Water Quality Due to Changes in Tributary Flows and Water Quality

Potential changes in water quality caused by changes in tributary contributions are anticipated to be negligible. Thus, under the Proposed Action and other action alternatives, any water quality change resulting from changes in tributary contributions would be negligible and limited to the fall of wet years.

Potential Changes in Water Quality Related to Treated Wastewater Discharges

The only modeled change in flow greater than 10% occurred in October of wet years. A potential change in water quality could occur due to the predicted changes in treated wastewater contributions for these limited periods. The impact of this discharge on water quality is unknown. Acute low flows are not expected to be affected and therefore a change to permit limits is not anticipated. With only one month of one hydrologic condition identified as being affected, this impact is considered negligible to minor.

Potential Changes in Water Quality Due to Changes in Water Quality and/or Release Patterns of Dillon Reservoir and/or Green Mountain Reservoir

Changes in Dillon Reservoir and Green Mountain Reservoir water quality are not anticipated, and therefore no changes are anticipated in water quality in the Blue River as a result of the Proposed Action or other action alternatives.

The Blue River from the outlet of Dillon Reservoir to the confluence with North Rock Creek is listed on the Monitoring and Evaluation List for Aquatic Life Use (CDPHE 2012). A discussion of the Aquatic Life Use listing and potential impacts related to the Proposed Action and other action alternatives is presented in Section 5.11 of the FEIS.

South Boulder Creek

South Boulder Creek is classified by CDPHE as a reviewable stream within the South Platte River Basin and delivers water to the Moffat WTP and other contract customers via the South Boulder Creek Canal downstream of Gross Reservoir. There are no water suppliers or treatment facilities diverting surface water between the Moffat Tunnel and Gross Reservoir per the EPA Envirofacts website.

Potential water quality changes under the Proposed Action and other action alternatives are as follows:

Changes in Concentrations of Contaminants in Source Water

Potential impacts to water quality in South Boulder Creek resulting from the Proposed Action or other action alternatives are related to changes in source water and the Moffat Tunnel permitted discharge. Impacts to source water or to the permitted discharge are not anticipated. Thus, impacts to water quality in South Boulder Creek as a result of the Proposed Action or other action alternatives are not anticipated.

Potential Changes to South Boulder Creek Below Gross Reservoir

Possible impacts to water quality in South Boulder Creek downstream of Gross Reservoir could result from changes in Gross Reservoir water quality. South Boulder Creek also has potential to impact drinking water providers through source water quality changes as well as potentially affecting WWTP dischargers.

As noted in Sections 4.6.2 and 5.2 of the FEIS, short-term increases in biological productivity may occur downstream of Gross Reservoir in South Boulder Creek, due to inundation of new areas associated with reservoir expansion. Short-term impacts are also anticipated to affect operations of the Moffat WTP. These short-term impacts on the Moffat WTP would also be directly related to enlargement of Gross Reservoir under the Proposed Action.

As noted in Sections 4.6.2 and 5.2 of the FEIS, impacts to wastewater dischargers downstream of Gross Reservoir are not anticipated.

Also as described in Sections 4.6.2 and 5.2 of the FEIS, outflow temperatures from Gross Reservoir are predicted to decrease with the Proposed Action due to expansion of the hypolimnion. Outflow temperature predictions of a hydrodynamic temperature model of Gross Reservoir (Hawley et al. 2013 in Appendix E-5 of the Moffat Project FEIS) indicate that peak outflow water temperatures would decrease on the order of 4.0 to 6.6 degrees Celsius (˚C) (for the range of conditions simulated), resulting in outflow water which is cooler than 9˚C throughout the year. A discussion of any aquatic life effects related to these temperature predictions is presented in Section 5.11 of the FEIS.

North Fork South Platte River

The North Fork South Platte River is highly influenced by water deliveries from Dillon Reservoir through the Roberts Tunnel. The North Fork South Platte River is reviewable, per CDPHE regulations. There are no major wastewater treatment facilities on the mainstem of the North Fork South Platte River. There are three minor (less than 0.1 mgd) wastewater treatment facilities. This is less than one-tenth of the estimated low flow, and thus, wastewater facilities have no impact on determination of change with regard to water quality.

The water quality in the North Fork South Platte River of the South Platte River is primarily influenced by the following:

- **Water Quality from the Headwaters of the North Fork South Platte River and Water Quality of Tributaries** – These are not influenced by the Proposed Action and other action alternatives and are not discussed further.
- **Water Quality in Dillon Reservoir as Delivered through the Roberts Tunnel** – No changes in the water quality in Dillon Reservoir are expected due to the Proposed Action or other action alternatives. Thus, there are no expected changes in water quality in the Roberts Tunnel due to the Proposed Action or other action alternatives.
- **Water Delivery (Volume and Timing) through the Roberts Tunnel** – Changing the proportion of the river between the headwaters of the North Fork South Platte River, deliveries from the Roberts Tunnel, and Geneva Creek (just downstream of the Roberts Tunnel) could have an impact on water quality. This is dependent on water quality of each of these sources.

Anticipated water quality changes under the Proposed Action and other action alternatives are as follows:

Changes Downstream of Roberts Tunnel Caused by Altered Diversions through Roberts Tunnel

As described in Section 4.6.2 of the FEIS, changes in the volume and timing of deliveries through the Roberts Tunnel would potentially impact water quality. Changes in water quality as a result of changes in source water flows (i.e., natural flow versus Roberts Tunnel flow) would be attributed to the action alternatives and from changes between Current Conditions (2006) and Full Use of the Existing System. Any decreases in flow through Roberts Tunnel would be the result of the action alternatives as flows under Full Use of the Existing System would increase when compared to Current Conditions (2006).

In average years, Roberts Tunnel deliveries would decrease for all action alternatives (including the Proposed Action) by approximately 15 to 18% during the months of November through March. During spring runoff months of May through July, the Roberts Tunnel deliveries would increase. In May, from the increase in Roberts Tunnel, deliveries would be approximately 58 to 60%; in June, the increase would be approximately 30 to 31%; and in July, the increase would be approximately 18 to 19%.

In dry years, Roberts Tunnel deliveries would change by more than 15% in two months as a result of the action alternatives. November deliveries would decrease by approximately 16%, and March deliveries would decrease by approximately 17%.

In wet years, Roberts Tunnel deliveries would change by more than 15% throughout winter months (decrease) and during spring runoff (increase) as a result of the action alternatives. In November through March, the decrease would range from 17 to 37%. In May through August, the increase would range from 15 to 67%. The annual average Roberts Tunnel deliveries would be 14% less under the action alternatives than under Full Use of the Existing System.

Impacts to WWTP Dischargers and Drinking Water Providers

The changes in Roberts Tunnel deliveries described above would result in minor impacts to concentrations of copper, iron, and nickel as described in Section 4.6.2 of the FEIS. Analysis shows that impacts are not anticipated for drinking water providers or wastewater dischargers on the North Fork South Platte River. Additionally, minimal changes in phosphorus loading in Chatfield Reservoir are anticipated due to the change in annual flows ranging from -2 to 3%. Thus, depending on the changes in Roberts Tunnel deliveries, impacts from the action alternatives are

anticipated to slightly increase or decrease the concentrations of copper, iron, and nickel. Nickel and iron are anticipated to remain below regulatory standards. The regulatory standard for copper changes with hardness levels, and with existing concentrations at or above the regulatory standard, the effects on copper concentration from the action alternatives are unknown with regard to the regulatory standard. However, impacts to copper concentrations resulting from the action alternatives are anticipated to be minimal.

South Platte River

For purposes of water quality analysis in the FEIS, the South Platte River was divided into the sections presented below. Anticipated water quality changes under the Proposed Action and other action alternatives are as follows:

Antero Reservoir to the Confluence with the North Fork South Platte River

Water quality is anticipated to remain within stream standards and no impacts are expected.

The South Fork South Platte River below Antero Reservoir is on the Monitoring and Evaluation List for Aquatic Life Use (CDPHE 2012). A discussion of the Aquatic Life Use listing and potential impacts related to the Proposed Action and other action alternatives is presented in Section 5.11 of the FEIS.

Confluence with the North Fork South Platte River to Chatfield Reservoir

During periods when there are decreases in flow through Roberts Tunnel, copper and nickel concentrations would increase. However, water quality is anticipated to remain within stream standards.

The South Platte River from the outlet of Cheesman Reservoir to the confluence with Fourmile Creek is on the Monitoring and Evaluation List for Aquatic Life Use (CDPHE 2012). A discussion of the Aquatic Life Use listing and potential impacts related to the Proposed Action and other action alternatives is presented in Section 5.11 of the FEIS.

Chatfield Reservoir to the Denver Gage

The South Platte River downstream of Chatfield Reservoir is highly regulated, with numerous withdrawals. Additionally, two major municipal wastewater treatment dischargers, Centennial Water and Sanitation District and the Bi-City WWTP, are located in this section of the South Platte River.

No impacts are anticipated except for a possible change in in groundwater flow, but this impact is not anticipated to be significant.

Denver Gage to Henderson Gage

No impacts to stream water quality are anticipated.

Impact on wastewater treatment providers would be as a result of either a change in water quality that would affect permit limits or a change in dilution flows. As there is already the potential for the river to be greater than 95% wastewater, no changes to permit limits are anticipated. The model indicates greater flow in the driest months, which would provide greater dilution flows for wastewater discharges theoretically improving water quality

The supply to the Moffat WTP is not from the South Platte River Basin; thus, the water quality for the plant inflow is not impacted by any changes in the South Platte River. Additionally, the supply for the remaining two Denver Water WTPs is upstream of this segment on the South Platte River; thus, any changes in this segment would not impact those treatment plants.

Stream Segments outside the Project Area Listed in Regulation 93 or Having a TMDL

Portions of the Colorado River, South Boulder Creek, and the South Platte River are listed in Regulation 93 on Colorado's 303(d) and Monitoring and Evaluation Lists. Some downstream segments also have TMDLs and are discussed below.

Anticipated water quality changes under the Proposed Action and other action alternatives are as follows:

Colorado River

No water quality changes are anticipated for the segments downstream of the Kremmling sample site under the Proposed Action or other action alternatives.

South Platte River

No water quality changes are anticipated for the segments downstream of Henderson under the Proposed Action or other action alternatives.

Boulder Creek

Boulder Creek from 107th Street to the confluence with Coal Creek is provisionally listed on the 303(d) List for Aquatic Life Use, and Boulder Creek from Coal Creek to St. Vrain Creek is on the Monitoring and Evaluation List for Aquatic Life Use (CDPHE 2012). A discussion of the Aquatic Life Use listings and potential impacts related to the Proposed Action and other action alternatives is presented in Section 5.11 of the FEIS.

No water quality changes are anticipated for the segments downstream of South Boulder Creek at SH 93 under the Proposed Action or other action alternatives.

4.3.3 Leyden Gulch Reservoir Site

Leyden Gulch Reservoir would be constructed under Alternative 1c. Leyden Gulch Reservoir water quality would primarily be influenced by the source water quality, reservoir operations, and site geology. The source water quality is anticipated to be similar to that of Gross Reservoir, anticipating minimal degradation during delivery via South Boulder Creek and the South Boulder Diversion Canal.

A large portion of the water stored in Leyden Gulch Reservoir would have been diverted during average and wet years when the inflow may have slightly elevated levels of TOC and turbidity that could affect reservoir water quality. In general, the impact to water quality from storing water in Leyden Gulch that would otherwise have been stored in Gross Reservoir under the Proposed Action should be greater than if all the water was stored in Gross Reservoir and that system was allowed to fluctuate in elevation as needed. Summer destratification, exposure and oxidation of sediments, and stress to aquatic organisms would be expected to be greater in Leyden Gulch.

The reservoir may be operated near capacity for extended periods, and minor variances in influent water quality in South Boulder Creek could have impacts over multiple years on the water quality in Leyden Gulch Reservoir. Water quality data to more fully evaluate this impact are not available; thus, precise impacts and their magnitudes are not known. The impact to water quality in Leyden Gulch (as compared to current water quality in Gross Reservoir) is minor.

4.3.4 South Platte River Facilities

Operation of the South Platte River gravel pit facilities would not significantly alter river flows in relation to Full Use of the Existing System and AWTP would control the potential for additional nutrient loading in Ralston Reservoir.

4.3.5 Denver Basin Aquifer Facilities

Operation of the Denver Basin Aquifer Facilities would not significantly alter river flows in relation to Full Use of the Existing System and CDPHE permit conditions would disallow degradation of the aquifer system.

4.4 CURRENT PATTERNS AND WATER CIRCULATION (230.23)

Current patterns and water circulation are the physical movements of water in the aquatic ecosystem. Currents and circulation respond to natural forces as modified by basin shape and cover, physical and chemical characteristics of water strata and masses, and energy dissipating factors (40 CFR 230.23[a]).

The discharge of dredge or fill material can modify current patterns and water circulation by obstructing flow, changing the direction or velocity of water flow and circulation, or otherwise changing the dimensions of a water body. As a result, adverse changes can occur in the location, structure, and dynamics of aquatic communities; shoreline and substrate erosion and deposition rates; the deposition of suspended particulates; the rate and extent of mixing dissolved and suspended components of the water body; and water stratification (40 CFR 230.23[b]). Section 5.1 of the Moffat Project FEIS contains detailed information about changes in stream flow and resulting changes in stream morphology that would occur under the various Moffat Project alternatives.

4.4.1 No Action Alternative

Diversions and flow augmentations under the No Action Alternative are unlikely to affect current patterns and water circulation. Reductions in stream flow could affect patterns and circulation on a number of streams, but changes are expected to be minor.

4.4.2 Action Alternatives

Expansion of Gross Reservoir or the construction of other Project features likely would not result in changes in current patterns and water circulation.

It is possible that reductions in stream flow would result in changes in current patterns and water circulation on the Fraser River, Williams Fork River, Colorado River, Muddy Creek, Blue River, and the South Platte River, but these changes are expected to be minor. Diversions would be greatest at high and average flow years.

4.5 NORMAL WATER FLUCTUATIONS (230.24)

Normal water fluctuations in a natural aquatic system consist of daily, seasonal, and annual tidal and flood fluctuations in water level. Biological and physical components of such a system are either attuned to or characterized by these periodic water fluctuations (40 CFR 230.24[a]).

The discharge of dredge or fill material can alter the normal water-level fluctuation pattern of an area, resulting in prolonged periods of inundation, exaggerated extremes of high and low water, or a static nonfluctuating water level. Such water level modifications may change salinity patterns, alter

erosion or sedimentation rates, aggravate water temperature extremes, and upset the nutrient and DO balance of the aquatic ecosystem. In addition, these modifications can alter or destroy communities and populations of aquatic animals and vegetation; induce populations of nuisance organisms; modify habitat; reduce food supplies; restrict movement of aquatic fauna; destroy spawning areas; and change adjacent, upstream, and downstream areas (40 CFR 230.24[b]).

Section 4.1 of the Moffat Project FEIS contains detailed information about changes in stream flow and resulting changes in stream morphology that would occur under the alternatives.

All of the alternatives would result in changes in stream flow, but none of the changes in stream flow are expected to result in significant long-term changes in stream morphology. Flow reductions would occur in the Fraser River, Williams Fork River, Colorado River, and the Blue River. Reductions in sediment transport capacity and supply are predicted to accompany flow reductions. The magnitude and frequency of larger flow events in these West Slope rivers are generally predicted to be reduced with all alternatives and as a result, localized sediment deposition may occur. Remaining flows are, however predicted to be sufficient so that sediment deposition would be temporary and channel morphology would be maintained in the long term. Flow increases in North Fork South Platte River and South Boulder Creek would increase both sediment transport capacity and supply. Additional localized erosion may result and could require stabilization measures. Localized instability is not expected to result in channel morphology changes at a significant scale.

4.6 SALINITY GRADIENTS (230.25)

Salinity gradients form where salt water from the ocean meets and mixes with fresh water from land (40 CFR 230.25[a]).

The Project area is not located in or near an ocean; therefore, salinity gradients would not be affected by the Moffat Project.

5. (SUBPART D) BIOLOGICAL CHARACTERISTICS

5.1 THREATENED, ENDANGERED, AND CANDIDATE SPECIES (230.30)

Threatened, endangered, and other special status species information is provided in Section 5.10 and Appendix G of the Moffat Project FEIS. The Final BO for the Proposed Action issued by the USFWS on December 6, 2013, which replaces the BO issued on July 31, 2009, is provided in Appendix G-2 of the Moffat Project FEIS, and contains conclusions and recommended actions for management of threatened or endangered species. The Corps submitted a request for reinitiation of consultation on August 14, 2012, in response to a February 16, 2010 letter from USFWS commenting on the DEIS. A Supplemental BA for greenback cutthroat trout is also being prepared.

5.1.1 No Action Alternative

Under the No Action Alternative (i.e., both the Depletion of the Strategic Water Reserve and Combination strategies), there would be no direct or indirect impacts to Federally listed species from construction of new facilities, but changes in operation of the existing system would result in changes in stream flow in areas occupied by Federally listed species. The impacts associated with these flow changes are discussed below. Because there would be no Federal action, the No Action Alternative would not require nor involve consultation with the USFWS regarding these impacts.

Four Federally listed endangered fish species occur downstream in the Colorado River. Flow reductions in the Colorado River resulting from the No Action Alternative would be very similar to those described for the Proposed Action, as discussed in the Moffat Project FEIS. In average and wet years, there would be a reduction of 2% in annual flows at the Kremmling gage on the Colorado River, mostly occurring in June and July in average years and in June in wet years. There would be no changes in dry years. Flow reductions would fall under the existing Recovery Agreement that Denver Water signed with USFWS in 2000.

Several Federally listed species occur downstream in the Platte River in Nebraska. As discussed in the Moffat Project FEIS, the No Action Alternative would result in an average annual increase of 1% in flows at the Henderson gage. Flows would remain the same or increase slightly in every month except June, when they would decrease by about 1%. The largest increases would be 3 to 5% in January, February, and March.

Preble's meadow jumping mouse (Preble's) and Ute ladies'-tresses orchid occur along South Boulder Creek downstream of the South Boulder Diversion Canal. Under the No Action Alternative, average annual flows would decrease by 1% compared to Full Use of the Existing System. All of the flow reduction would occur in May and June, when flows are highest. In wet years, flows would decrease by 2 to 3% in May and June. There would be no reductions in flows in dry years. Similar to the Proposed Action, the smaller changes in flows under the No Action Alternative are unlikely to adversely affect habitats used by these species along South Boulder Creek.

Preble's occurs along the South Platte River from below Cheesman Reservoir to Chatfield Reservoir. As discussed in the Moffat Project FEIS, changes in the outflow of Cheesman Reservoir would be minor, including small increases in winter (1 to 3% on average from October to February) and decreases in summer (-1% in June, July, and August). Dry years would have increased flows (8 to 14% increases on average from May to September). Wet years would show no changes overall, except slightly decreased flows in the fall. These changes are unlikely to adversely affect riparian habitats used by Preble's, and may have minor beneficial impacts because of increases in dry years during the warmer months. Changes at the Waterton gage would be similar to, but slightly larger than, the Proposed Action with a decrease of 4% in annual flows in average years, 2% in wet years, and 1% in dry years. Decreases would occur most of the year except winter in average and dry years. However, in dry years, flow decreases would be greatest in November (10% on average). Similar to the Proposed Action, these small changes would not likely result in adverse changes to riparian habitat occupied by Preble's in the area between Waterton Canyon and Chatfield Reservoir.

Preble's also occurs along portions of the North Fork South Platte River. There would be an average increase of 7% in annual flows during average and wet years, and 3% increase in dry years. Increases in flows would occur throughout the year, and would range from 2 to 11% per month in average years. Because flows would increase during the growing season, changes in flows are unlikely to adversely affect Preble's habitat.

5.1.2 Proposed Action

Gross Reservoir

As discussed in Section 3.10.1.1 and shown in Appendix Table G-1 of the Moffat Project FEIS, one Federally listed species, greenback cutthroat trout, has the potential to occur at Gross Reservoir. Construction and operation of the expanded reservoir are not likely to adversely affect this species. Although greenback cutthroat trout were stocked in Gross Reservoir in 2002 and 2004, they were

not found in 2007. Hatchery raised fish are unlikely to live more than five years, and it is unlikely that any will be present at the time of construction. In addition, the greenback cutthroat trout stocked at Gross Reservoir appear to be of hybrid origin, and they were stocked to support a recreational fishery and not as part of a recovery effort. There is no evidence that greenback cutthroat trout have reproduced in Gross Reservoir. A Supplemental BA is being prepared to address greenback cutthroat trout.

Impacts to other special status species described in Section 5.10 and Appendix G of the Moffat Project FEIS from enlargement of Gross Reservoir would include direct and indirect, permanent and temporary impacts as described below. The primary direct impact would be loss of habitat from reservoir enlargement and the associated facilities. Seven of the 11 special status wildlife species are migratory birds, including northern goshawk, flammulated owl, bald eagle, American tree-toed woodpecker, olive-sided flycatcher, American peregrine falcon, and black swift. Disturbance to nesting migratory birds would be avoided or minimized by procedures described in FEIS Section 5.10.7, if practicable, trees in the construction footprint would be cleared prior to March 1 or after July 31 to avoid take of or disturbance to active nests. If construction begins after March 1 or prior to July 31, nest surveys would be conducted prior to construction to minimize the potential for impacts to active nests in or near the area of clearing. If surveys are needed, appropriate survey protocol would be used for each of the species of concern addressed by the survey.

The Proposed Action would not affect any USFS Region 2 sensitive species, but would affect several species of local concern in the ARNF. For several species, inundation would destroy a large portion of the known populations in the Gross Reservoir area. USFS policy, stated in Forest Service Manual 2600, is to maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on USFS land. Because of the size of the populations and the relatively high proportion of plants affected, Project impacts may affect the long-term viability of populations of several species within the ARNF. Mitigations recommended by the USFS (Popovich 2011) are provided in Section 5.10.7 of the FEIS.

Table 5.10-1 in Section 5.10 of the Moffat Project FEIS provides the estimated number of plants of each species that are present within the area of inundation and tree-clearing. Plants within the inundation area would be destroyed by flooding. Plants within area of tree-clearing around the reservoir perimeter could be destroyed or injured by movement of equipment and construction activity, but impacts are avoidable. Most of these species occur in open areas where tree clearing would not be necessary or would be limited. Impacts to plants in the tree-clearing area are avoidable if populations are located and marked in advance of clearing, and vehicles and mechanical equipment are not allowed to operate within the sensitive area.

River Segments

Downstream Colorado River Endangered Fish Species

Four Federally listed endangered fish species—Colorado pikeminnow, razorback sucker, bonytail, and humpback chub—occur downstream of the Project area in the Colorado River. Critical habitat for endangered Colorado River fish extends from Rifle downstream to Lake Powell. Depletions adversely affect the listed species by reducing peak spring and base flows that limit access to and the extent of off-channel waters such as backwaters, eddies, and oxbows, which are necessary rearing areas for young fish.

Under the Proposed Action, changes in flow in the Fraser, Williams Fork, Colorado, and Blue rivers would adversely affect Colorado River fish by causing water depletions in the upper Colorado River system. Depletions of any amount are considered by the USFWS to be an adverse impact. Under the Proposed Action, average annual diversions from the upper Colorado River would increase by

10,285 AF/yr through the Moffat Tunnel, which includes water diverted from the Fraser River and from the Williams Fork River through the Gumlick Tunnel, and 4,836 AF/yr through the Roberts Tunnel, which diverts from the Blue River. These additional diversions translate into a 2% decrease in flow of 15,121 AF/yr (20.9 cfs) on average in the Colorado River. Decreases in flow in the Colorado River would be a result of Denver Water's increased diversions through the Moffat and Roberts tunnels. Denver Water's average annual diversions through the Moffat Tunnel would increase by 10,300 AF/yr. This includes water diverted from the Fraser and Williams Fork rivers (via the Gumlick Tunnel). Denver Water's average annual diversions through the Roberts Tunnel would increase by 4,800 AF/yr. These additional diversions translate into a decrease in flow of 15,121 AF/yr on average at the Colorado River near the Kremmling gage. Monthly average decreases in flow would be greatest during May and June and range up to 6%.

Consultation with USFWS is required under Section 7 of the Endangered Species Act (ESA) prior to authorization of any Federal action that may adversely modify critical habitat, which includes alteration of flow volume or timing (i.e., depletion). In 1999, the USFWS issued a Programmatic BO with specific elements to implement the Recovery Implementation Program for Endangered Fish Species in the upper Colorado River Basin (Recovery Program). In 2000, Denver Water signed a Recovery Agreement with the USFWS, which governs consultations under Section 7 of the ESA regarding depletions associated with Denver Water's facilities. The BO issued by the USFWS on December 6, 2013 determined that the proposed depletions to the Colorado River from implementing the Proposed Action would be covered under Denver Water's Recovery Agreement. Mitigation would be done through payment of a one-time fee to cover the costs of acquisition of water rights and other recovery actions to offset the depletion effect, and would be included as a stipulation in the Section 404 Permit.

Downstream South Platte River Endangered and Threatened Species

Several endangered or threatened species occur downstream in the South Platte River in Nebraska, including the whooping crane, least tern, piping plover, pallid sturgeon, Eskimo curlew, and western prairie fringed orchid. Similar to the Colorado River, depletions to the South Platte River system are considered by the USFWS to have an adverse impact on the four target species: whooping crane, least tern, piping plover, and pallid sturgeon. Under the Proposed Action, average annual flows at the South Platte River at the Henderson gage would increase by 2%. The increase in flows would be due primarily to Denver Water's and the City of Arvada's additional effluent returns at the Metro WWTP, and additional return flows accruing to the river due to outdoor water usage. Increases in flow would be greatest during the winter months from October through April. During those months, Denver Water's additional direct diversions from the South Platte River are minimal and there would be less demand for reusable effluent.

During the summer months, flows would decrease on average by up to 1%. Denver Water's additional direct diversions and exchanges upstream would exceed the additional return flows to the South Platte River during these months. The monthly average change in flows range from a 9% increase in December to a 1% decrease in May and June. The average annual depletion from the South Platte River Basin would be 1,607 AF. Thus, under the Proposed Action, changes in flow in the South Platte River in average years would adversely affect the whooping crane, least tern, pallid sturgeon, and western prairie fringed orchid in the central and lower Platte River Platte River in Nebraska.

In 2007, the USFWS issued a Programmatic BO and began implementing the Platte River Recovery Implementation Program (PRRIP) to address water-related activities affecting flow volume and timing in the central Platte River in Nebraska. Denver Water is a member of the South Platte Water Related Activities Program, Inc. (SPWRAP), which provides continued Programmatic coverage

under the PRRIP for Denver Water's existing and future South Platte River Basin water depletions. In the Final BO issued on December 6, 2013, the USFWS determined that the proposed depletions to the South Platte River from implementing the Proposed Action would be covered by Denver Water's continued participation and membership in SPWRAP. Denver Water's annual assessments to SPWRAP help to support the water user and State of Colorado obligations under the PRRIP.

Preble's Meadow Jumping Mouse

South Boulder Creek – A population of Preble's is present downstream from Gross Reservoir along South Boulder Creek (USFWS 2006). Water released from Gross Reservoir via South Boulder Creek is diverted at the existing South Boulder Diversion Canal. Under the Proposed Action, average annual flows below the South Boulder Diversion Canal would decrease by 985 AF due to additional diversions of native South Creek water to storage at Gross Reservoir and at the South Boulder Diversion Canal. Denver Water would not divert South Boulder Creek native water between November and March if diversion caused water flow to drop below 7 cfs downstream of the South Boulder Diversion Canal diversion point.

Downstream of the South Boulder Diversion Canal, flows in South Boulder Creek would generally decrease on average because Denver Water would divert more native South Boulder Creek water, either to store at Gross Reservoir or under their direct flow diversion rights at the South Boulder Diversion Canal. These additional diversions would occur in wet years during peak runoff in May and June, and would reduce average annual flows below the canal by about 1,000 AF (2%). Wet year average annual flows would decrease by 3,000 AF (5%), and dry year flows would increase by 150 AF (<1%). Riparian habitats occupied by Preble's near South Boulder Creek would still be maintained by water supplied from irrigation canals. Therefore, the decrease in flow to South Boulder Creek in wet years would not likely affect Preble's habitat in occupied areas downstream of the diversion canal. In the December 6, 2013 BO, the USFWS concurred with the determination of "not likely to adversely affect" Preble's in Colorado.

South Platte River and North Fork South Platte River – Changes in flow in the South Platte River and in the North Fork South Platte River may affect, but are unlikely to adversely affect Preble's occupied habitat in the area between Waterton Canyon and Chatfield Reservoir, and occupied habitat upstream along the South Platte River between Cheesman and Chatfield reservoirs. Average annual flow in the stretch of the South Platte River below Cheesman Reservoir would not change. However, average monthly flows would decrease during the winter months by up to 6% in March and increase during the summer months by up to 4% in May. In general, flows below Cheesman Reservoir would be lower on average during winter months because the Moffat WTP would operate in those months under the Proposed Action; therefore, releases of stored water to Strontia Springs Reservoir would decrease.

Average annual flows would decrease at the South Platte River at Waterton gage by 3%. Average monthly flows would increase by up to 6% in November and decrease by up to 5% in June. Denver Water's direct diversions and exchanges to Strontia Springs Reservoir and Conduit 20 would change primarily in response to changes in Moffat WTP operations and the shift in seasonal operations between Denver Water's North and South system WTPs, as well as the overall higher level of demand that would be met under the Proposed Action. As a result, South Platte River flows at the Waterton gage would decrease on average in the summer months. There would be little change in flows at Waterton gage in most winter months from October through March; however, flow increases would occur occasionally. Increases in flows would be primarily in response to increased direct diversions and exchanges and the impact of load shifting between Denver Water's WTPs. Because flows would not be reduced in dry years, and would have relatively small changes

in average and wet years, Project related changes are unlikely to adversely affected Preble's or its habitat along the South Platte River.

Changes in flow under the Proposed Action in the North Fork South Platte River may affect, but are unlikely to adversely affect Preble's occupied habitat. Changes in flow would occur because of the shift in seasonal operations between Denver Water's northern and southern WTPs. Deliveries through the Roberts Tunnel would be lower in winter and higher in summer. Average annual flow would increase by 3%, as shown in Appendix H, Table H-3.41, of the Moffat Project FEIS. Average monthly flows would decrease during the winter months of November to March by 25 to 30% and would increase by 13-29% during the months of May through September. Dry year annual flows would increase by about 1%, and wet year annual flows would decrease by about 2%. Changes in winter flows would be generally similar (as a percentage) in average, dry, and wet years. Increases in summer flows would be less and for shorter periods during dry and wet years than during average years. Because flows would increase during the growing season, changes in flows are unlikely to adversely affect Preble's habitat. Reductions in flow during the winter months are unlikely to affect the availability or use of hibernacula. In the December 6, 2013 BO, the USFWS concurred with the determination of "not likely to adversely affect" Preble's in Colorado.

Greenback Cutthroat Trout and Colorado River Cutthroat Trout

All of the core conservation populations and conservation populations of Colorado River cutthroat trout, including greenback lineage populations in the Fraser and Williams Fork tributaries from which water is diverted, occur above the diversions. The diversions are mostly considered to be complete or partial barriers, and all of the populations are described by Hirsch et al. (2006) as isolated with the exception of North, Middle and South Fork Ranch creeks, which are considered weakly connected. Fish that move downstream of the diversions are therefore generally lost to the populations above the diversions. The source populations would not be affected by the flow changes below the diversions. Changes in flows below the diversions have the potential to affect individual fish, but would not affect the conservation populations.

The diversions do not include screens to prevent entrainment, and entrainment is likely to occur. The Project alternatives do not include any physical modifications to the diversion structures or operations with the exception of increased water diversions. The diversion structures are therefore not analyzed in the FEIS. The risk of entrainment from operation of the Moffat Collection System may increase because of the increased water diversions. Current rates of entrainment are unknown. Given the small size of the stream segments above them, the existing Moffat Collection System diversions may represent a substantial entrainment risk for native cutthroat trout. It is also possible that the isolated cutthroat trout populations upstream of these diversions have already lost their mobile component because downstream migrants cannot return to isolated headwater populations. The cutthroat trout populations upstream of the diversions have sustained themselves for decades with the diversions functioning and entraining fish.

The Proposed Action is likely to adversely affect greenback cutthroat trout because of increased entrainment into the Moffat Collection System during periods of increased stream diversions. A Supplemental BA is being prepared to address this species.

Canada Lynx

Canada lynx may regularly use riparian areas along some of the tributaries of the Fraser River including Vasquez and St. Louis creeks, and may occasionally use riparian areas along some of the other river segments including Fraser River, Williams Fork and its tributaries, Blue River, and the western portion of South Boulder Creek. The Proposed Action would have negligible to minor effects on riparian habitats in these areas, primarily involving changes in vegetation composition

(see Section 5.8 in the FEIS). These changes are unlikely to change habitat suitability or habitat use by Canada lynx. Lynx primarily use forested areas and have large home ranges, and small and localized changes in riparian habitat would be unlikely to affect habitat overall habitat use. In addition, the Proposed Action would not involve any construction, clearing of vegetation, or change of human use activity in Canada lynx habitat. In its 2013 BO, the USFWS concurred with the determination of "no effect" for this species.

Ute Ladies'-tresses Orchid

Ute ladies'-tresses orchid occur downstream from Gross Reservoir along South Boulder Creek. As discussed for Preble's, flow diversions at the South Boulder Diversion Canal would generally decrease flow in South Boulder Creek, which would be "not likely" to adversely affect populations of Ute ladies'-tresses orchid occurring downstream. Average year flow would be decreased by 1,000 AF (2%) and wet years by 3,000 AF (5%), while dry years would increase by 150 AF (<1%).

Changes in flow in the South Platte River would have no impact on Ute ladies'-tresses orchid because there are no known occurrences in this area. In its 2009 BO, the USFWS concurred with the determination of "not likely to adversely affect" for this species.

River Otter

River otters occur along the Fraser, Colorado, and Blue rivers, but the tributaries of the Fraser River and the upper Williams Fork River are not part of their overall range (NDIS 2007). Flow changes would have minor or negligible impacts on riparian habitats along these rivers (Section 5.8 of the FEIS), negligible to beneficial impacts to fish in the Fraser River, and no effect to the fish community in the Colorado and Blue rivers (Section 5.11 of the FEIS). Changes in water levels would not affect access to dens in winter because flow changes during winter months would be relatively small, 0 to -6% from November to March in the upper and middle Fraser rivers (Appendix H, Tables H-3.2, H-3.6, H-3.11, and H-3.17 in the Moffat Project FEIS), and -3 to +3% in these months in the lower Fraser, Colorado, and Blue rivers (Appendix H, Tables H-3.22, H-3.23, H-3.31, H-3.32, H-3.33, and H-3.36 in the Moffat Project FEIS). In addition, river otters choose dens opportunistically and often use beaver bank dens, dams and lodges, and are highly mobile (Boyle 2006). Based on these considerations, impacts would be negligible and would not affect distribution or abundance of river otter.

Boreal Toad

Boreal toads are known to occur along the upper Williams Fork and may occur along the Fraser River and its main tributaries, including Vasquez Creek. They are unlikely to occur along the Blue River and South Boulder Creek upstream of Gross Reservoir, where habitat is marginally suitable and there are no known breeding sites.

Boreal toads have three distinct habitat needs – breeding ponds, summer habitat, and hibernacula. Breeding occurs in a wide variety of water bodies such as beaver ponds, kettle ponds, streams, large reservoirs, and man-made ponds, in areas with shallow pooled or slow-moving water. Egg and tadpole development are temperature dependent, and eggs are deposited in shallow warm water that optimizes warmth of the sun. During the summer, boreal toads use a wide variety of wet and dry, forested and non-forested habitats. Adult boreal toads have been observed spending up to 90% of their life in upland terrestrial habitats (Jones et al. 2001). Hibernation occurs in terrestrial habitats, mostly in underground rodent burrows. Boreal toads may migrate up to about 1.5 miles between breeding ponds and hibernacula. Longer movements of up to 5 to 6 miles between small populations have been recorded.

The Project would not directly or indirectly affect known breeding sites. Boreal toads breed in ponds, most commonly in beaver ponds. The upper Williams Fork boreal toad breeding site is located very near the Williams Fork, but is supported by groundwater and surface flow from aside drainage and is located several feet higher in elevation than the Williams Fork. The Jim Creek and Vasquez Creek breeding sites in the Fraser Valley also appear to be supported by groundwater and have no recent breeding records. The McQueary Lake breeding site in the William Fork Valley and the Pole Creek breeding site in the Fraser Valley are located far upstream on tributaries.

The Project is unlikely to adversely affect availability of summer habitat and hibernacula. Flow changes are expected to have minor or negligible impacts on riparian habitats (refer to Section 5.8 of the FEIS). Boreal toads use a wide variety of habitats during the summer and are not restricted to streamside areas. Large areas of both upland and riparian habitats in the Fraser and Williams Fork valleys are potential summer habitat, and small changes in streamside riparian habitats are unlikely to adversely affect their population or distribution. The Project would not involve any construction activity in their habitat and would not cause direct effects or transmission of disease.

Interior Least Tern and Piping Plover

These species are very rare migrants at the South Platte River and adjacent reservoirs, and are unlikely to incur impacts from flow changes under the Proposed Action.

Common Shiner

There are no recent records of this species in the portion of the South Platte River in the Project area, and it is unlikely to be affected by flow changes.

Other Special Status Species

Other species status species that may occur along the river segments include American peregrine falcon, bald eagle, various aquatic birds, northern leopard frog, and several plant species (Appendix G, Table G-5 in the Moffat Project FEIS). Flow changes in other Project river segments are unlikely to affect these species because the flow changes would not noticeably affect availability of suitable habitat for aquatic or riparian species.

American peregrine Falcon. This species nests along or near several of the river segments and is likely to forage along the rivers. Flow changes are unlikely to change the availability of prey or foraging conditions.

American bittern. This species may occur in marshes along the lower Fraser, Colorado River, and South Platte River. Operation of the Project is unlikely to affect marsh habitat, which typically is associated with impoundments or areas of high groundwater.

American white pelican may occur in the lower South Platte River although it is more likely to occur in lakes and ponds than in the river itself. The Proposed Action would have a minor beneficial impact to fish populations that may benefit this species.

Bald eagle nests, roost sites, and/or foraging areas are located along the Fraser, Colorado, Blue, North Fork South Platte and South Platte rivers. Flow changes are expected to have minor or negligible impacts on riparian habitats and fish populations, and are unlikely to change the availability of prey or foraging conditions.

Barrow's goldeneye winters on reservoirs and rivers, including the Colorado River and South Platte River. The Proposed Action does not involve increased diversions in winter and would have no effect on habitat for this species.

Greater sandhill crane may occur on migration along the North Fork South Platte and the South Platte rivers. Migrants occur on mudflats around reservoirs, in moist meadows and agricultural lands (Andrews and Righter 1992). The Proposed Action would have no effect on these habitats.

Ovenbird is a rare migrant that may occur in riparian areas along the lower South Platte River. The Proposed Action would have negligible effects on the availability of migration habitat because flows in the South Platte River would not be reduced in dry years and would have relatively small changes in average and wet years.

Snowy egret occurs along the South Platte River and may occur along the North Fork South Platte River, but appears to nest primarily on islands in lakes. Flow changes are unlikely to change the availability of prey or foraging conditions along rivers.

White-faced ibis may occur during migration along the South Platte River. Flow changes under the Proposed Action are unlikely to change the availability of prey or foraging conditions for this species.

Northern leopard frog has the potential to occur along all of the river segments but is more likely to occur in ponds and wetlands than in the rivers themselves. Predatory fish in the rivers are likely to strongly limit use of this habitat. Flow changes in the rivers under the Proposed Action would affect relatively narrow areas along the river banks and are not expected to affect availability of pond habitat.

Common garter snake occur along the lower South Platte River. Flow changes under the Proposed Action are expected to have a negligible effect on riparian habitat and unlikely to change the availability of prey or foraging conditions.

Iowa darter occurs in Eleven Mile Canyon Reservoir, which is located along the South Platte River. Iowa darters were also collected in 2003 and 2005 in the South Platte River between Chatfield Reservoir and the confluence with Bear Creek reservoirs and occur in downstream sections of the river. Chatfield Reservoir is drawn upon in multi-year droughts, and reservoir operation and contents under the Proposed Action would be similar to Current Conditions. The Proposed Action is unlikely to affect this species.

Park milkvetch may occur in sedge meadows and grassy stream banks along montane portions of the North Fork South Platte and South Platte rivers. Operation of the Proposed Action is expected to have negligible effects on riparian habitats along these rivers, and impacts to this species would also be negligible, if it is present.

Least moonwort, lesser panicled sedge, mud sedge, dwarf raspberry, and autumn willow are species that primarily occur in fens and peatlands in montane and subalpine areas, and may occur along the river segments in the Fraser and Williams Fork valleys. Changes in stream flows resulting from the Proposed Action would have no or negligible impacts to habitats of these plants, which are primarily supported by groundwater.

Buckbean and lesser bladderwort occur in montane and subalpine ponds. Changes in stream flows under the Proposed Action are expected to have no impacts to ponds.

American current occurs in lowland riparian areas along the South Platte River. Operation of the Proposed Action is expected to have negligible effects on riparian habitats along the South Platte River, and impacts to this species would also be negligible, if it is present.

Rocky Mountain bulrush may occur in ponds along the South Platte River. Changes in stream flows under the Proposed Action are expected to have no impacts to ponds.

5.1.3 Alternative 1c

Gross Reservoir

Under Alternative 1c, there would be no impacts to Federal and State listed species at Gross Reservoir.

Impacts to other special status species from Alternative 1c would be similar to described under the Proposed Action, but less as the reservoir would only be enlarged by 40,700 AF. Impacts to special status wildlife habitat would be reduced. Forest birds and terrestrial and burrowing species such as dwarf shrew, would incur less habitat loss.

Alternative 1c would not affect Maryland sanicle, and the number of affected individual plants affected would be reduced substantially for Dewey sedge and Sprengle's sedge compared to the Proposed Action (Table 5.10-1). In addition, only two of the four reported locations for false melic would be affected. Impacts to other plant species of local concern, including wild sarsaparilla, enchantress's nightshade, and tall blue lettuce, would be the same or similar to the Proposed Action. This alternative may affect viability of tall blue lettuce and false melic in the ARNF, and also affect the local viability of populations of wild sarsaparilla and enchantress's nightshade.

Leyden Gulch Reservoir Site

Preble's Meadow Jumping Mouse

The proposed Leyden Gulch Reservoir site has potential habitat for Preble's at Ralston Creek; however, due to fragmentation from known occupied habitat above Ralston Dam, the site would not likely support a population of Preble's. Therefore, implementation of Alternative 1c is unlikely to adversely affect Preble's and associated habitat.

Ute Ladies'-tresses Orchid

No Ute ladies'-tresses orchid were observed on the site during 1997 and 2005 surveys, and construction and operation of Leyden Gulch Reservoir would not likely adversely affect this species. Construction of the reservoir would temporarily impact suitable Ute ladies'-tresses orchid habitat at Ralston Creek for the outlet pipeline, as well as 4.5 acres in the reservoir footprint.

Colorado Butterfly Plant

Construction of Leyden Gulch Reservoir would have no impact on Colorado butterfly plant as the species has not been documented in or is expected to occur at the site. The proposed Leyden Gulch Reservoir site does contain some areas of suitable habitat for Colorado butterfly plant at some riparian and wetlands areas such as Leyden Gulch and Ralston Creek. No Colorado butterfly plants were found during 2005 surveys.

Burrowing Owl

Suitable nesting habitat for burrowing owls in the black-tailed prairie dog colonies at Leyden Gulch would be eliminated by reservoir construction. The presence of burrowing owls at the site is not known as no presence/absence surveys have been conducted for the Project. Denver Water is trying to eradicate the existing prairie dogs at Leyden Gulch, leaving a large number of prairie dog burrows unoccupied, which makes them more suitable for nesting burrowing owls. Surveys would be required to determine if burrowing owls occur at Leyden Gulch during the nesting season (April 1 to September 30). Earth-moving and vegetation-clearing activities occurring during the burrowing owl nesting season would cause owls to flush the nest or equipment could crush eggs, young, and adult burrowing owls. Rising water levels may flood nests during reservoir filling.

Other Special Status Species

Bald eagles are present in the vicinity of Leyden Gulch in winter. Disturbance from construction may result in avoidance of the area by bald eagles. Following inundation of the reservoir, bald eagles would lose a small prey base of prairie dogs at Leyden Gulch, but it would be replaced following construction of the reservoir by waterfowl and fish, if conditions were suitable. As discussed in Section 3.9 of the FEIS, fish may become established in Leyden Gulch Reservoir from South Boulder Diversion Canal. Construction of Leyden Gulch Reservoir under Alternative 1c would not adversely impact bald eagles.

Approximately 7.2 acres of existing prairie dog colonies would be removed for construction of Leyden Gulch Reservoir. Besides the mortality of prairie dogs, the proposed reservoir would eliminate habitat for numerous other species that are associated with prairie dog colonies, including ferruginous hawk. The primary impact of Leyden Gulch Reservoir to peregrine falcon and ferruginous hawk under Alternative 1c would be loss of foraging habitat.

Northern leopard frog was observed in the proposed Leyden Gulch Reservoir site during 2005 field surveys. Impacts to northern leopard frog include direct loss of habitat as well as mortality to individual frogs by crushing or burial during earth moving activities for construction of the dam, pipeline, or access roads.

Several species of butterfly may occur at Leyden Gulch (see Table G-3 in Appendix G of the Moffat Project FEIS) and would lose habitat from construction of the reservoir. Suitable habitat for these species occurs in areas adjacent to the reservoir site so the Project is not expected to impact the viability of populations of these species.

Plant species, such as dwarf wild indigo, that may be present in the proposed reservoir footprint would be removed by construction or inundation.

River Segments

Operation of Alternative 1c would have the same effects on aquatic and riparian species as the Proposed Action. Operation would result in depletions to the Colorado and South Platte rivers, but adverse effects to listed species that occur in and along downstream rivers would be mitigated in accordance with the recovery programs. Operation would not adversely affect downstream habitat for Preble's, Canada lynx, and Ute ladies'-tresses orchid. Conservation populations of greenback cutthroat trout and Colorado River cutthroat trout above the diversions are likely to be adversely affected by increased entrainment resulting from increased diversions. Operation is likely to have no effects on State listed species including river otter and boreal toad. Stream flow changes resulting from operation of the Project are expected to have no or negligible adverse effect to other special status species.

5.1.4 Alternative 8a

Gross Reservoir

Under Alternative 8a, there would be no impacts to Federal and State listed species.

Impacts to other special status species from Alternative 8a would be similar to the Proposed Action, but less as Gross Reservoir would only be enlarged by 52,000 AF, compared to 77,000 AF with the Environmental Pool for mitigation for the Proposed Action. Forest birds and terrestrial and burrowing species would incur less habitat loss.

Alternative 8a would affect fewer individuals of Dewey sedge, Sprengle's sedge, and Maryland sanicle, compared to the Proposed Action (Table 5.10-1). Impacts to other special status plant

species, including wild sarsaparilla, enchantress's nightshade, tall blue lettuce and false melic, would be the same or similar to the Proposed Action. This alternative may affect viability of Sprengle's sedge, tall blue lettuce and false melic in the ARNF, and local viability of populations of wild sarsaparilla, Dewey sedge, and enchantress's nightshade.

South Platte River Facilities

Construction of the diversion pipeline, dam, and AWTP would potentially disturb foraging bald eagles, especially if construction occurs during winter months. These impacts would be short term and direct and would primarily cause avoidance by bald eagles during construction activity.

Burrowing Owl

If burrowing owls occur where prairie dogs are present along the gravel pit pipeline corridor, impacts would consist of temporary disturbance to nesting individuals during pipeline construction. If construction occurs during the burrowing owl breeding season (March 15 through July 31), heavy equipment operation and earth moving may cause nest abandonment or mortality from crushing or burial if a nest is located near the construction ROW.

Interior Least Tern and Piping Plover

Similar to bald eagles, the filling of the gravel pits under Alterative 8a would create habitat for migrating interior least terns and piping plovers. Construction of the associated facilities may temporarily disturb these birds during migration; however, considering the rarity of the species in the area, least terns are unlikely to incur impacts from construction.

Ute Ladies'-tresses Orchid and Colorado Butterfly Plant

There are no known occurrences of these species and construction of the South Platte River Facilities would not adversely affect them. The South Platte River at the diversion is within the Block Clearance Zone where these species are considered to not be present and presence/absence surveys would not be needed.

Other Special Status Species

Other special status species that may occur at the South Platte River Facilities include bald eagle, peregrine falcon, white pelican, Barrow's goldeneye, snowy egret, white-faced ibis, black-tailed prairie dog, northern leopard frog, and common garter snake.

Construction of the diversion pipeline, dam, and advanced water treatment pump station would potentially disturb or displace foraging bald eagles, especially if construction occurs during winter months. The South Platte River corridor adjacent to the proposed gravel pits is used by bald eagles for foraging year-round and is a winter concentration area (NDIS 2007). Operation of the Worthing, South Tower, and North Tower gravel pits would benefit bald eagles by creating approximately 5,000 AF (approximately 200 acres) of open water habitat that would provide an increased prey base of waterfowl and potentially fish. Fish may establish in the gravel pit reservoir from diversion canals. The Project would have no impact on nesting bald eagles since the nearest active bald eagle nests are located more than 3 miles from the South Platte River Facilities (NDIS 2007). A bald eagle communal roost is located near the crossing of the South Platte River at 112th Avenue. Construction and operation would not affect this roost as no facilities are planned within 1 mile of the roost.

Construction and operation of the facilities would have no impacts on peregrine falcons as the species occurs in the area during foraging and other habitats are available. Operation of the gravel pit storage ponds would be beneficial to white pelicans and Barrow's goldeneye through creation of open water habitat. Snowy egrets and white-faced ibis would also benefit from creation of shoreline

habitat at the gravel pits, though both species would also incur direct and temporary impacts from temporary loss of habitat from construction of the diversion pipeline south of Worthing Pit.

Northern leopard frog and common garter snake would primarily incur impacts where the gravel pit pipeline crosses riparian and wetland habitats as shown on Figure 3.6-4 in Chapter 3 of the Moffat Project FEIS. Small terrestrial species including northern leopard frog, common garter snake, and black-tailed prairie dogs would be directly impacted by ground disturbance for construction of pipelines and pump stations. Heavy equipment and earth moving may kill individual animals by crushing or burial. At the time of this analysis, no black-tailed prairie dog colonies would be impacted for the pipelines.

Conduit O

Suitable habitat for four Federally protected species is located within or adjacent to Conduit O—interior least tern, piping plover, Ute ladies'-tresses orchid, and Colorado butterfly plant. Construction of the pipeline for Conduit O would be within existing roadways and would only disturb areas within the existing ROW. Conduit O would cross the South Platte River, Clear Creek, and other drainages as open cut.

Burrowing Owl

Impacts to burrowing owl would consist of temporary disturbance during construction activity. Areas of potential habitat for burrowing owls occur near Conduit O occur in prairie dog colonies, including the western terminus of the pipeline in the vicinity of SHs 72 and 93, the vicinity of the South Platte River crossing, and south of the gravel pits. If construction occurs during the burrowing owl breeding season (March 15 through July 31), heavy equipment operation and earth moving may cause nest abandonment or mortality from crushing or burial if a nest is located near the construction ROW.

Interior Least Tern and Piping Plover

The least tern and piping plover are very rare migrants along the South Platte River and these species would not likely incur impacts from Alternative 8a construction.

Ute Ladies'-tresses Orchid and Colorado Butterfly Plant

There are no known occurrences of these species and construction of Conduit O and would not adversely affect these species. Potential habitat for Ute-ladies'-tresses orchid and Colorado butterfly plant is present where Conduit O crosses the South Platte River but this area is within the Block Clearance Zone where they are not expected to occur and pre-construction surveys would not be needed.

Other Special Status Species

Other special status with habitat crossed by Conduit O include bald eagle, Barrow's goldeneye, ferruginous hawk, snowy egret, white-faced ibis, black-tailed prairie dog, swift fox, and common garter snake.

Impacts to bald eagles may include temporary disturbance during construction activities. Important bald eagle habitat occurs at Standley Lake, north of Conduit O, and therefore, bald eagles may occasionally fly over the conduit during foraging or migrating, but construction would not affect bald eagles occurring near Standley Lake. As shown on Figure 3.10-1 in Chapter 3 of the Moffat Project FEIS, bald eagle habitat also occurs at the South Platte River. Heavy equipment use and earth moving for construction of Conduit O at the South Platte River would cause temporary and direct impacts to bald eagles from disturbance. Impacts to bald eagles from construction of Conduit O would be limited to avoidance of the area during construction activity.

Disturbance to Barrow's goldeneye, ferruginous hawk, snowy egret, and white-faced ibis from construction activity would cause temporary displacement for the duration of the disturbance. Since construction would occur within the existing roadway, no black-tailed prairie dog colonies would be removed; impacts would be limited to temporary disturbance to individuals located adjacent to the construction activity. Swift fox may occur in habitats crossed by Conduit O east of the South Platte River; construction of the conduit may cause individuals to avoid the area for the duration of construction. Impacts to common garter snake include crushing from heavy equipment and earthmoving where the snake may be present along roadsides at riparian crossings and wetlands.

River Segments

Impacts to Federally listed species occurring in the river segments would be the same as described under the Proposed Action, except that the amount of depletions in the Colorado River system would be less and depletions to the South Platte River would change. The average annual decrease in flow at the Colorado River near Kremmling gage would be 12,740 AF versus 15,121 AF under the Proposed Action and the average annual increase in flow at the South Platte River near Henderson gage would be 2,700 AF versus 4,300 AF under the Proposed Action.

5.1.5 Alternative 10a

Gross Reservoir

There would be no impacts to Federal and State listed species under Alternative 10a.

Impacts to other special status species under Alternative 10a would be the same as Alternative 8a.

Denver Basin Aquifer Facilities

Construction or operation of the AWTP would not affect interior least tern since it would be constructed adjacent to the South Platte River in a highly industrialized area. Therefore, this species are unlikely to occur in the vicinity of the advanced water treatment other than flying over the area during migration or foraging.

Habitat for American white pelican, northern leopard frog, and common garter snake is present in the Denver Basin aquifer storage site area. American white pelicans may occasionally be present in the vicinity of the aquifer wells, where wells would be placed in parks with open water habitat including City Park, Sloan's Lake, and Washington Park. Construction of wells is unlikely to impact pelicans as drilling would be temporary and the species occurs on open water habitats away from well drilling. Construction of the AWTP and aquifer distribution pipelines where they cross Sand Creek, Clear Creek, South Platte River, and Cherry Creek may eliminate habitat and crush or bury individual northern leopard frog or common garter snake, if present, in the construction footprint. Construction or operation of the AWTP would not affect bald eagle because the AWTP would be constructed adjacent to the South Platte River in a highly industrialized area.

Conduit M

The alignment for Conduit M is the same for Conduit O between the Moffat Delivery Point and the intersection of 80th Avenue and Pierce Street. Impacts to Federally protected species from Conduit M east of 80th and Pierce streets are described below.

Ute Ladies'-tresses Orchid and Colorado Butterfly Plant

A new population of Colorado butterfly plant was discovered along Clear Creek in 2011, within 0.5 mile of the Conduit M crossing. Presence/absence surveys have not been conducted at the

Conduit M crossing of Clear Creek and this species could occur at the crossing. There are no known occurrences of Ute ladies'-tresses orchid in the vicinity of Conduit M. The South Platte River crossing is within the Block Clearance Zone for both species, where they are not expected to occur and surveys would not be necessary. Surveys would be conducted at Clear Creek and other areas of suitable habitat outside the Block Clearance Zone prior to construction to determine the presence or absence of these plants, and to avoid impacts if present.

Burrowing Owl

Areas of potential habitat for burrowing owls occur in prairie dog colonies near western terminus of the pipeline in the vicinity of SHs 72 and 93. If construction occurs during the burrowing owl breeding season (March 15 through July 31), heavy equipment operation and earth moving may cause nest abandonment or mortality from crushing or burial if a nest is located near the construction ROW. The FWMP (refer to Appendix M in the Moffat Project FEIS) which has been approved by the Colorado Wildlife Commission, and Denver Water has committed to conducting pre-construction surveys to identify active nests in the Project footprint and timing of activities to avoid the breeding season.

Other Special Status Species

Other special status habitats crossed by Conduit M include bald eagle, peregrine falcon, ferruginous hawk, Barrow's goldeneye, snowy egret, black-tailed prairie dog, and arogos skipper butterfly. Construction occurring during winter may temporarily disturb foraging or day roosting bald eagles near Standley Lake or along the South Platte River. However, due to the industrial land uses in the vicinity, impacts to bald eagles would be minimal. Disturbance to peregrine falcon, ferruginous hawk, Barrow's goldeneye, and snowy egret from construction activity would cause temporary displacement for the duration of the disturbance. Construction would occur within the existing roadway and no black-tailed prairie dog towns would be removed. Arogos skipper would not incur any impacts as construction would occur in the existing ROW.

River Segments

Impacts to Federally protected species would be the same as described under the Proposed Action, except the amount of depletions in the Colorado River system would be less and depletions to the South Platte River would change. The average annual decrease in flow at the Colorado River near Kremmling gage would be 12,800 AF versus 15,121 AF under the Proposed Action and the average annual increase in flow at the South Platte River near Henderson gage would be 3,300 AF versus 4,300 AF under the Proposed Action.

5.1.6 Alternative 13a

Gross Reservoir

Alternative 13a would have no impacts to Federal and State listed species at Gross Reservoir.

Impacts to other special status species under Alternative 13a would be similar but less than those described under the Proposed Action as the reservoir would only be enlarged by 60,000 AF. Terrestrial and burrowing species and forest birds would incur less habitat loss.

Alternative 13a would affect fewer individuals of Dewey sedge and Maryland sanicle, compared to the Proposed Action (Table 5.10-1). Impacts to other special status plant species, including wild sarsaparilla, Sprengle's sedge, enchantress's nightshade, tall blue lettuce and false melic, would be the same or similar to the Proposed Action. This alternative may affect viability of Sprengle's

sedge, tall blue lettuce and false melic in the ARNF, and local viability of populations of wild sarsaparilla, Dewey sedge, and enchantress's nightshade.

South Platte River Facilities

Impacts from gravel pits would be similar to Alternative 8a. Transfer of agricultural water rights on 3,900 acres of land would not affect any Federally listed threatened or endangered species.

Conduit O

Impacts to Federally protected species from construction of Conduit O would be the same as the impacts described for Alternative 8a.

River Segments

Impacts to Federally protected species would be the same as described under the Proposed Action, except the amount of depletions in the Colorado River system would be less and depletions to the South Platte River would change. The average annual decrease in flow at the Colorado River near Kremmling gage would be 13,600 AF versus 15,121 AF under the Proposed Action and the average annual increase in flow at the South Platte River near Henderson gage would be 5,700 AF versus 4,300 AF under the Proposed Action.

5.2 FISH, CRUSTACEANS, MOLLUSKS, AND OTHER AQUATIC ORGANISMS

Fish and other aquatic species are discussed in Section 5.11 of the Moffat Project FEIS.

5.2.1 No Action Alternative

Depletion of Strategic Water Reserve Strategy

Under the No Action Alternative, Denver Water would continue to operate its existing system. The hydrology for the No Action Alternative would be much different compared to all other alternatives. Diversions from the Fraser River and Williams Fork River tributaries would be much less than for all the action alternatives. There would be no changes to water quality or channel morphology that would affect aquatic biological resources in most of the stream segments in the Project area. For Fraser River tributary streams without bypass flows, vegetative encroachment and channel narrowing would continue. Impacts of flow changes on the fish and invertebrate community are described below. In almost all cases, there would be no changes that would be sufficient to cause a stream to cross an ecological tipping point.

Gross Reservoir

Gross Reservoir would not be enlarged under the No Action Alternative. Reservoir volume would be lower (by up to 11% in some months). The reservoir would also be drawn down to the minimum pool approximately 50% more often. There would be a minor adverse impact to the fish and invertebrate community of Gross Reservoir under the No Action Alternative.

Fraser River

The No Action Alternative would divert more water from the Fraser River Basin tributaries in average and wet years compared to Full Use of the Existing System. The differences in flow with the No Action Alternative would be much less than for the action alternatives. The annual flow reductions in the Fraser River would range from 2% at Granby (PACSM Node 2900) up to 7% downstream of the Denver Water diversion on the Fraser River (PACSM Node 2120) compared to Full Use of the Existing System conditions.

The small differences in flow between the No Action Alternative and Full Use of the Existing System would result in small differences in habitat availability. For most life stages of brook, brown, and rainbow trout in the Fraser River the differences in minimum habitat availability would be 1% or less most of the time. There would be increases in juvenile habitat of up to 15% in average years for rainbow and brown trout with the reductions in runoff flows. The similarity in habitat availability for most life stages indicates that the No Action Alternative would have a negligible impact on aquatic biological resources in the Fraser River compared to Full Use of the Existing System. However, under certain conditions, bypass flows may not be met below diversions in the Fraser River Basin. This could further reduce flows compared to existing and Full Use of the Existing System during periods of low habitat availability for fish and invertebrates. If bypass flows are not met, there would be a minor adverse impact to aquatic resources and possibly water temperature in the upper Fraser River.

Fraser River Tributaries

Reductions in flow in Fraser River tributaries between the No Action Alternative and Full Use of the Existing System conditions would be one third to one half as much as would be diverted with the Proposed Action. Compared to Full Use of the Existing System conditions, the No Action Alternative would divert approximately twice as much water in average and wet years. In dry years, there would be no additional diversions compared to Full Use of the Existing System conditions. The differences would not affect the low winter flows that are now present in many of these streams.

In many of the Fraser River tributaries, the increased diversions with the No Action Alternative are less than with the Proposed Action compared to Full Use of the Existing System conditions. These streams would have a negligible impact to aquatic resources with the No Action Alternative. This includes the St. Louis Creek tributaries, King Creek, Main Elk Creek and tributaries, Cooper Creek, Middle Fork and South Fork Ranch Creek, Wolverine Creek, Cub Creek, Buck Creek, North Fork Ranch Creek, Main Ranch Creek, Dribble Creek, and the streams in the Englewood Ranch Gravity System.

In St. Louis and Vasquez creeks, the No Action Alternative would have flows similar to Full Use of the Existing System. Reductions in flow due to additional diversions would be limited to up to a few cubic feet per second and up to 13% less flow in some months of average and wet years, respectively. The similarities in flow would result in similarities in simulated habitat availability for brook trout. There would be no differences in habitat availability greater than 3%. The No Action Alternative would have a negligible impact on fish and invertebrates in St. Louis and Vasquez creeks.

In Jim Creek and Little Vasquez Creek, the changes in flow with the No Action Alternative would be less than for the Proposed Action, but would still be sufficient to result in a minor adverse impact. The impact would be similar to the impact for the Proposed Action.

Reductions in flow in Fraser River tributaries between the No Action Alternative and Full Use of the Existing System would generally be less than 10%. The differences would not affect the low winter flows that are now present in many of these streams. The No Action Alternative would have no impact on the fish and invertebrate communities in these tributary streams. However, under certain conditions, bypass flows may not be met below diversions in the Fraser River Basin. This could further reduce flows compared to Full Use of the Existing System during periods of low habitat availability for fish and invertebrates. If bypass flows are not met, there would be a minor to moderate adverse impact to aquatic resources in the affected streams.

Williams Fork River

Changes in Williams Fork River mainstem flows under the No Action Alternative would be minimal, usually 3% or less in all months. Changes in the minimum habitat availability for brook trout would be less than 1% in average, wet, and dry years. The No Action Alternative would have a negligible impact on the fish and invertebrate communities in the Williams Fork River.

Williams Fork River Tributaries

The No Action Alternative would divert more water from the Williams Fork tributaries in some months. In average and wet years, reductions in some of the spring and summer months would be up to 22%. In most months and in dry years, there would be no reductions in flow. The changes in flow under the No Action Alternative would be less than the action alternatives. The No Action Alternative would have a minor adverse impact on fish and invertebrates in the tributaries.

Colorado River

Changes in flow under the No Action Alternative in the Colorado River would be 5% or less in most cases and less than 10% in all cases. Fish habitat availability would be very similar to Full Use. The No Action Alternative would have a negligible impact on fish and invertebrates in the Colorado River.

Blue River

Reductions in Blue River flows under the No Action Alternative would be greatest (up to 20%) in May, June, July, and August of average years between Dillon Reservoir to Rock Creek; and greatest (up to 11%) in June and August in between Rock Creek to Green Mountain Reservoir. However, average monthly flows in July would change by less than 10%. In wet years, there would be reductions in flow of up to 27% in some of the fall and winter months. The changes in flow would not result in changes in minimum habitat availability for trout greater than 6%. Therefore, the No Action Alternative would have a negligible impact on fish and invertebrate populations on the Blue River. However, under certain conditions, bypass flows may not be met in the Blue River downstream of Dillon Reservoir. This could further reduce flows compared to Full Use of the Existing System during periods of low habitat availability for fish and invertebrates. If bypass flows are not met, there would be a minor adverse impact to aquatic resources in the Blue River.

South Boulder Creek

The flows under the No Action Alternative would be similar to Full Use of the Existing System. The increases in average annual flows above Gross Reservoir would all be 3% or less. Changes in habitat availability from Full Use of the Existing System mostly would be less than 5% for all life stages of trout in the segments of South Boulder Creek both upstream and downstream of Gross Reservoir. The No Action Alternative would have a negligible impact on the fish and invertebrate communities on South Boulder Creek.

North Fork South Platte River

With the No Action Alternative, the changes in flow in the North Fork South Platte River would be less than 10% in most months of average, wet, and dry years. Changes greater than 10% would occur in some of the fall and winter months. For average years between the Roberts Tunnel and Buffalo Creek, flows would be 10 to 11% higher in winter months. In wet years, flows in October and through the winter months would be 10 to 18% higher. Between Buffalo Creek and the South Platte River, there would be no differences in flow greater than 10% in average and dry years, but in wet years, there would be increases in October and through the winter months of 10 to 15%.

There could be increases in copper concentrations, which already sometimes exceed standards. Increased flows are expected to increase bank instability. The changes in flow with the Proposed Action would result in some reductions in habitat availability for brown trout. The effects to brown trout could be exacerbated by localized bank instability and changes in water quality. These effects could lead to decreases in trout density in the North Fork South Platte River. The increases in flows during runoff and increased concentrations of copper may result in lower density or fewer species of macroinvertebrates although there may be more rheophilic species. Overall, there would be a minor adverse impact.

South Platte River

Flow changes to the South Platte River upstream of the North Fork would be minor. There would be no impact to aquatic resources to the river or the reservoirs in this section. The small changes in hydrology in the segments of the South Platte River between the North Fork and Chatfield Reservoir likely will have a negligible impact to aquatic resources.

The No Action Alternative would have flows similar to Full Use of the Existing System in the coldwater segment of the South Platte River downstream of Chatfield Reservoir. Differences in flow would be less than 10% in almost all months in average, wet, and dry years. However, there would be reductions in flow of 10% in September of average years; of 13 to 22% in December, May, and June of dry years; and of 17% in December of wet years.

Almost all of the changes to rainbow trout habitat availability under the No Action Alternative would be less than 10%. However, minimum spawning habitat would be reduced by 18%, 50%, and 20% in average, dry, and wet years. Since rainbow trout spawning is limited or absent, this difference would not affect the population. There would also be more habitat availability for adults and juveniles in dry years with slightly higher flows in winter. The overall similarity in most flow and habitat parameters indicates that the No Action Alternative would have no impact on the fish and invertebrate community of this segment of the South Platte River.

Combination Strategy

There would be no significant differences to aquatic biological resources under the No Action Alternative Combination Strategy. In dry years, flow changes would be similar under either No Action Strategy. Refer to Section 4.6.1.6.4 of the Moffat Project FEIS for a discussion regarding the flow changes under the Combination Strategy for surface water resources.

Under the Combination Strategy, imposing restrictions would generally have the impact of reserving more water in storage; therefore, storage contents in Denver Water's reservoirs could be higher in dry years. Whether storage contents are higher depends on several factors. The amount and location of water reserved in storage would vary depending on the severity and duration of restrictions imposed, on storage conditions in Denver Water's North and South systems, and on hydrologic conditions. Since storage contents could be higher with restrictions, Denver Water's diversions into storage after a drought could be less and stream flows could increase for a short duration after Denver Water's reservoirs refill. However, this would not occur if a reservoir is drained even with restrictions in place. Conversely, with greater restrictions, during a drought stream flows would be less in some streams as Denver Water would decrease its releases from storage and divert additional water if bypass flows are reduced. Decreases in stream flows from less water being released from storage to meet demand could occur in South Boulder Creek below Gross Reservoir, the North Fork South Platte River, and South Platte River. Decreases in stream flows because bypass flows are reduced applies to several locations in the Fraser River Basin, the Blue River below Dillon Reservoir, and along the South Platte River below Eleven Mile Canyon Reservoir and Cheesman Reservoir, and at the Old Last Chance Ditch Diversion. Changes in

stream flow between the two No Action Alternative strategies are not expected to be significant. If bypass flows are not met, there would be a minor adverse impact to aquatic resources in the affected streams.

5.2.2 Proposed Action

Gross Reservoir

The enlargement of Gross Reservoir would provide more habitat for fish and invertebrates. The final size of the reservoir would be 842 surface acres with the Environmental Pool, approximately twice the size of the existing reservoir. The water quality of the enlarged reservoir would be suitable for supporting fish. This would be a moderate beneficial impact to the reservoir fishery. The enlarged reservoir would support more fish than the existing reservoir and may provide opportunities for additional species of fish to become established. The enlarged reservoir is expected to have short-term increases in levels of MeHg and there may be increases in fish tissue levels of mercury for an undetermined period following reservoir enlargement. Therefore, the enlarged Gross Reservoir would likely be on the 303(d) List for high levels of mercury in fish tissues like many other East Slope reservoirs in Colorado.

Forsythe Canyon and Winiger Gulch are two small tributary streams to Gross Reservoir and portions of these streams would be inundated with an expanded reservoir. Approximately 1,350 feet of Forsythe Canyon and 2,160 feet of Winiger Gulch would be inundated. There would be a major adverse impact to the fish and/or macroinvertebrate communities in these streams. Approximately 5,000 feet of South Boulder Creek would also be inundated with the expanded reservoir and would transform this section of stream habitat into reservoir habitat. This would represent a major adverse impact to this section of stream but a moderate beneficial impact to the reservoir.

River Segments

Fraser River

In the Fraser River, the Proposed Action would result in reductions in flow during the runoff period compared to Full Use of the Existing System. Between Vasquez Creek and St. Louis Creek, the reductions in monthly flow in May, June, and July of average years would be from 23 to 38% (up to 46 cfs). There would be no reductions in dry years, but there would be reductions of up to 35% (68 cfs) in May and June of wet years. In other times of the year in average, wet, and dry years, the changes in flow would be small, usually less than about 6% (less than 10 cfs). Below St. Louis Creek, the pattern would be similar, although the percentage of the differences would be smaller. Downstream of Ranch Creek, flows in June and July of average years would be 19% (89 cfs) and 14% (23 cfs) lower, respectively, compared to Full Use of the Existing System. In the lower Fraser River near Granby, the extent of the changes in flows would be 17% (89 cfs) or less in average years and 10% (114 cfs) or less in wet years. The overall pattern of the flow regime will be the same throughout the river, with highest flows during spring runoff and lowest flows in the winter, which is an important concern in maintaining the aquatic community of the Fraser River.

There would be no changes to most water quality parameters or riparian vegetation that would affect aquatic biological resources. Historically, there have been only two days of daily maximum temperature exceedances in these segments. However, the reductions in flow in late summer would result in a negligible to minor impact along the river from Fraser to Granby. This may result in slightly higher water temperatures on the few extremely hot days of the year in late summer in

average and wet years. There are not expected to be more frequent temperature exceedances. There would be no change in dry years.

Flow reductions will likely result in localized sediment deposition, however remaining flows are predicted to be high enough to mobilize sediment at a frequency that changes in channel morphology are not anticipated. Flushing of fine sediments and bed mobilization would continue with the Proposed Action. Therefore, there would be no increase in habitat for the *T. tubifex* that carry whirling disease. The slightly higher temperatures on a few of the hottest days may inhibit the worms' capacity to spread the parasite, but this effect would probably be too infrequent to have any effect. Overall, the Proposed Action would not have an effect on whirling disease in the Fraser River. Adequate flows and the similarity in base flows in late summer and in the sediment transport capabilities of the Fraser River indicate that the Proposed Action would have no effect on Didymo as well. The Proposed Action would not change the current system of diversions and canals and would not introduce any new pathways for nuisance species distribution.

For brook trout, simulated habitat relationships were available for adult and spawning life stages for the upper Fraser River upstream of St. Louis Creek (Segments 1 and 2). The habitat relationships for adult brook trout for the Fraser River indicate that the low flows of winter result in relatively low habitat availability. There is approximately half as much habitat availability in winter as compared to the summer months. The winter represents the critical period of the year with the poorest habitat conditions. There is greater habitat availability during the runoff period. In many streams, reductions in peak runoff flows would result in increased habitat availability for trout. However, in the Fraser River, the reductions in peak flows with the Proposed Action would have no effect on the low habitat availability during the critical winter period. The Proposed Action would result in very similar habitat availability for adult brook trout for much of the year with only minor changes in habitat in mid-May through August. The lack of differences in fall and winter flows between the Proposed Action and Full Use of the Existing System would result in differences in minimum habitat availability of 3% or less from Full Use of the Existing System in average and wet years. There would be no changes in dry years.

Habitat relationships were available for adult, juvenile, and spawning life stages of brown trout and rainbow trout from St. Louis Creek to the Colorado River (Segments 2 through 5). For Segment 3 (St. Louis Creek to Ranch Creek), low habitat availability occurs during peak runoff in mid-June, for both adults and juveniles. The reductions in flow during runoff under the Proposed Action would result in greater minimum habitat availability in average years, no changes in dry years, and minimal changes of 3% or less in wet years. For Segment 4 (Ranch Creek to Mouth of Canyon), minimum habitat availability occurs in winter for both adults and juveniles and there would be only 1% or less difference between the Proposed Action and Full Use of the Existing System. Minimum spawning habitat availability would not change for rainbow trout. Although there would be increased habitat for rainbow trout fry under the Proposed Action, there is little successful rainbow trout reproduction in the Fraser River and the population is maintained mostly through stocking. The differences in habitat availability for all life stages of rainbow and brown trout would be less than 2% in wet years and there would be no changes in dry years. There would be minimal changes in habitat availability of 1% or less in the lower Fraser River (Segment 5) for rainbow and brown trout,

The differences in habitat availability for brook, brown, and rainbow trout for the Proposed Action compared to Full Use of the Existing System would be minor. The Proposed Action would have a negligible to minor impact on the fish community in most segments of the Fraser River. In Segment 3 of the middle Fraser River, the increases in minimum fish habitat availability would result in a moderate beneficial impact.

Habitat suitability for benthic invertebrates is usually more favorable at lower runoff flows. At high flows, invertebrates can be dislodged and flushed downstream or can be crushed by movements of the bottom substrate. The reductions in runoff flows with the Proposed Action would tend to have a beneficial impact on the invertebrate community of the Fraser River compared to Full Use of the Existing System. The invertebrate communities with the Proposed Action may include more species and higher density than Full Use of the Existing System.

Fraser River Tributaries

There would be additional diversions on tributary streams in average and wet years with the Proposed Action compared to Full Use of the Existing System. There would be no additional diversions in dry years in any of these streams. The timing of the seasonal pattern of spring runoff when flows bypass the diversions would not change substantially although the magnitude and duration would be reduced in some years. The Proposed Action would not substantially increase the frequency and duration of dry years in any of the Fraser River tributaries compared to Full Use of the Existing System.

Many of the tributary streams are fully diverted at times with Current Conditions and would be with Full Use of the Existing System, have limited or no fish population, and have macroinvertebrate communities limited to species tolerant of low flows. Many of these streams also have groundwater and wetland inputs that allow more robust aquatic communities at increasing distances downstream of the diversions. Most of these streams are already past tipping points.

Based on information from Jim Creek, many of the tributaries that are fully diverted at times are currently undergoing channel narrowing and vegetative encroachment. With flow reductions as a result of the Proposed Action, this narrowing could continue or be accelerated (refer to FEIS Section 5.3). This could be the case with many of the Fraser River tributaries without bypass flows.

St. Louis Tributaries – The PACSM node for the St. Louis Creek tributaries includes the hydrology for West St. Louis Creek, Short Creek, Iron Creek, Byers Creek, East St. Louis Creek, and Fool Creek. The Proposed Action would divert 42% more water from these streams in average years and 18% more water in dry years on an average annual basis. The diversions would mainly be during runoff, but more water would also be diverted in at other times of the year as well. The additional diversions would extend the period of no flow past the diversions by one to two weeks on average. There would be no additional diversions in dry years compared to Full Use of the Existing System.

All of these tributary streams are severely diverted streams that are sometimes dry below the diversions with Full Use of the Existing System. The streams would continue to pass flow past the diversions during some periods of high flows, but there are no bypass requirements for these streams. The hydrology for these streams indicates that water passes the diversions only during the high flow months in most years, May through July (Table H-3.13 in the Moffat Project FEIS). During the rest of the year the streams are fully diverted and resume flowing at varying distances downstream as water enters the streams from tributaries, groundwater, and wetlands (see Section 3.9.5.1 of the Moffat Project FEIS). The periods in severely diverted streams when water does not pass the diversions represent stressful conditions for aquatic organisms, especially in winter, the period of lowest flow and cold temperatures. The Proposed Action would not change flow conditions during the critical winter months in the St. Louis Creek tributaries, and other tributaries, but would reduce the flows that pass the diversions in wet months and extend the period when water does not pass the diversion. The St. Louis Creek tributaries have not been individually studied, but streams below diversions with no bypass flows likely already have some channel narrowing and vegetative encroachment (refer to FEIS Section 5.3) and this likely would accelerate. The Proposed Action would have a minor adverse impact on the aquatic organisms in these streams.

St. Louis Creek – In St. Louis Creek downstream of the Denver Water diversion, on an average annual basis there would be 16% less water in average years and 10% less in wet years. The additional diversions would be during the runoff period. There would be no changes in water temperatures or sediment accumulation. St. Louis Creek is a mildly diverted stream with bypass flows in summer and winter. The reductions in flow would result in a minor adverse impact for the Proposed Action in the upper section of St. Louis Creek.

In the lower section of St. Louis Creek, the differences in hydrology with the Proposed Action indicate that runoff flows during May, June, and July would be up to 21% (21 cfs) in average years and up to 12% (23 cfs) in wet years based on mean monthly flows. However, daily flow data indicate that peak flows would be similar between Full Use of the Existing System and the Proposed Action. Physical Habitat Simulations (PHABSIMs) were available for St. Louis Creek from a site included in the Grand County Stream Management Plan (Grand County 2008). The similarity in daily peak flow between the Proposed Action and Full Use of the Existing System would result in no change in minimum habitat availability for brook trout and benthic invertebrates. Therefore, there would be a negligible impact in the lower section of St. Louis Creek.

King Creek – In King Creek, average annual flows downstream of the diversion would be reduced by 43% in average years and 17% in wet years with the additional diversions occurring throughout the year. This tributary is a severely diverted stream with Full Use of the Existing System with no bypass flow requirements that has very low or no flow through the winter, which probably represents the most stressful period for aquatic organisms. This stream does not support fish upstream or downstream of the diversion but has a community of invertebrates. The reductions in flow with the Proposed Action would not change winter flows but would reduce the flows that pass the diversions during wet months and extend the period when water does not pass the diversion. This would have a minor adverse impact compared to Full Use of the Existing System.

Elk Creek and Tributaries – The PACSM node includes Main Elk Creek, West Elk Creek, East Fork Main Elk Creek, West Fork Main Elk Creek, and East Elk Creek. The additional diversions with the Proposed Action would reduce flows by 28% in average years and 16% in wet years on an average annual basis. Most of these tributaries are severely diverted with low or no flow in winter past the diversions, but West Elk Creek contains populations of fish and invertebrates downstream of the diversion. There are no bypass flow requirements for these streams. The reductions in flow in the wet months and the extension of the period of no flow past the diversion with the Proposed Action would result in minor adverse impacts compared to Full Use of the Existing System.

Vasquez Creek – The Proposed Action would result in lower flows in the runoff period compared to Full Use of the Existing System. In lower Vasquez Creek, flows would be 30 to 38% (up to 24 cfs) lower in May, June, and July of average years. In dry years, there would be no differences in flow between the Proposed Action and Full Use of the Existing System. In wet years, monthly flows would be up to 43% (32 cfs) lower during runoff.

Habitat simulation data were available for the adult and spawning life stages of brook trout in Vasquez Creek. Minimum habitat availability occurs during the lowest flows of the year in March for adult brook trout in Vasquez Creek. There would be slightly more habitat for adult brook trout during runoff. However, minimum habitat would be unchanged for both life stages in all three year types for the Proposed Action compared to Full Use of the Existing System. Flows in the fall months would not change much and spawning habitat availability would be similar for the Proposed Action and Full Use of the Existing System in all three year types. The reduced flows and resulting macroinvertebrate community changes would have a minor adverse impact on aquatic resources in Vasquez Creek. The decrease in wetted area associated with the increased diversions would probably lead to smaller macroinvertebrate populations.

Little Vasquez Creek – In Little Vasquez Creek, average annual flow would be 61% lower in average years and 38% lower in wet years. The additional diversions would occur throughout the year. This stream has no bypass flow and very low or no flow downstream of the diversion through the winter with Full Use of the Existing System but supports fish and invertebrates downstream of the diversion. The Proposed Action would reduce the flows that pass the diversion in the wet months and extend the period when no flow passes the diversion and have a minor adverse impact on aquatic resources in Little Vasquez Creek.

Cooper Creek – Additional diversions on Cooper Creek would result in 31% lower flow in average years and 38% in wet years on an average annual basis. The diversions would mostly reduce flows during runoff. There is no bypass flow for this stream and it is fully diverted most of the time with low or no flow through the stressful winter period. The additional diversions during wet months would have a minor adverse impact for the Proposed Action compared to Full Use of the Existing System.

Jim Creek – The additional diversions in Jim Creek with the Proposed Action would result in 51% less water in average years and 30% in wet years on an average annual basis. The additional diversions would occur primarily in May and June but could occur throughout the year. There is no bypass flow for Jim Creek and it is fully diverted much of the year but it supports fish in the short section downstream of the diversion. This stream has very low or no flow through the winter, which probably represents the most stressful period for aquatic organisms. The additional diversions in wet months and the extension of the time of full diversion with the Proposed Action would have a minor adverse impact.

North Fork Ranch and Dribble Creeks – Downstream of the Denver Water Diversion on the North Fork Ranch Creek, the Proposed Action would result in 24% lower flow in average years and 11% in wet years on an average annual basis. Additional diversions would be greatest in June with average flows decreasing by up to 23% (4 cfs) in that month. Diversions in other summer months would be up to 41% (1 cfs). Reductions in flow of this magnitude would have a minor adverse impact on the fish and invertebrate communities in North Fork Ranch and Dribble creeks.

Main Ranch Creek – At Ranch Creek downstream of the Denver Water diversion, there would be 14% less water on average with up to 21% (4 cfs) lower flow in May, June, and July of average and wet years with the Proposed Action. There would be no additional diversions in other times of the year or in dry years. The flow in this section of Ranch Creek is very low in the winter months, near 1 cfs.

A PHABSIM for brook trout was available for Ranch Creek. Minimum habitat availability for adult brook trout occurs in March and April at the lowest flows of the year, and availability is highest during spring runoff in median, wet, and dry years. Flows proposed under the Proposed Action do not produce any appreciable changes in minimum or average habitat availability for adult or spawning brook trout in median, dry, or wet years. The low flows in winter are probably the critical low habitat period in this stream for fish and probably also for invertebrates. The similar flows in these months with both the Proposed Action and Full Use conditions indicate that minimum habitat availability in winter would not change.

Main Ranch Creek has a bypass flow requirement and consistently supports fish. Sediment transport capacity and supply would be reduced with predicted flow changes. Additional sediment deposition may occur in localized areas but deposition is expected to be limited in duration. Flows sufficient to mobilize sediment and maintain existing stream characteristics are predicted to remain. Late summer low flows are not expected to change appreciably and high water temperatures would not change appreciably. The Proposed Action would reduce flows below the diversion in wet months. This

would extend the period of low flows in the stream by one week on average. The Proposed Action would have a minor adverse impact on the fish and invertebrate communities of Ranch Creek.

Middle Fork and South Fork Ranch Creeks – These streams are fully diverted at times. The additional diversions with the Proposed Action would result in 37% lower flows in average years and 15% lower flows in wet years on an average annual basis. These streams have very low or no flow through the winter, which probably represents the most stressful period for aquatic organisms. The Proposed Action would not change flows in winter in most years but the reduced flows past the diversions in wet months and the extension of the period when the streams are fully diverted would have a minor adverse impact in these two streams.

Wolverine Creek – There is no PACSM node for Wolverine Creek. We assume that more water would be diverted during the wet months similar to nearby streams. This very small stream has no bypass flow and is fully diverted much of the year with low or no flow through the winter. The additional diversions during the wet months with the Proposed Action would have a minor adverse impact compared to Full Use conditions.

Cub and Buck Creeks – Additional diversions on Cub Creek and Buck Creek would reduce flows by 31% in average years and 27% in wet years on an average annual basis primarily in May, June, and July. These two small streams have no bypass flow and are fully diverted much of the year with low or no flow through the winter. The additional diversions during the wet months with the Proposed Action would have a minor adverse impact compared to Full Use of the Existing System.

Englewood Ranch Gravity System – The Englewood Ranch Gravity System includes diversions on Little Cabin, Cabin, Hurd, Hamilton, South Trail, North Trail, and Meadow creeks. With the Proposed Action, changes in flow would be only 3% in average and wet years on an average annual basis. Maximum diversions would be only 8% (1 cfs) in June of average years. All of these streams have bypass flows that would be met with the Proposed Action. The minimal changes in flow with the Proposed Action would have a negligible impact on fish and invertebrates in these streams.

Williams Fork River

The segment of the Williams Fork River upstream of the South Fork to the confluence of headwater tributaries was evaluated for the FEIS. Hydrology from the Williams Fork above Darling Creek gage was used to simulate habitat for adult and spawning life stages of brook trout. The hydrology for the Proposed Action indicates small reductions in flow of 4% (1 cfs) or less in most months of the year and larger reductions of 11% (18 cfs) in June and July of average years. There would be no reductions in dry years, and in wet years, additional reductions would be limited to the May through September period. There would be no changes to water quality, riparian vegetation, or channel morphology that would affect aquatic resources in the Williams Fork River.

The pattern of habitat availability for adult brook trout in Segment 1 of the Williams Fork River indicates minimum habitat during runoff. The reductions in runoff flows with the Proposed Action would tend to provide greater habitat availability for adult brook trout. However, changes in the minimum habitat availability for adults would be less than 5% in average, wet, and dry years. The minor changes in flow during the fall spawning period for brook trout would result in minor changes in spawning habitat availability in average, wet, and dry years. For aquatic resources, the small differences in flow for the Proposed Action would have a negligible impact compared to Full Use of the Existing System.

Williams Fork River Tributaries

The Proposed Action would include additional diversions of water from McQueary, Jones, Bobtail, and Steelman creeks, which form the headwaters of the Williams Fork River. At these tributaries, the additional diversions would be up to 30% in average years and 10% in wet years. The hydrology for the Williams Fork River at a point just downstream of these four tributaries indicates additional diversions would result in 22% less water in average years and 8% less in wet years, with reductions occurring primarily in June and July. The diversions would include up to 37% (18 cfs) lower flows during runoff.

Downstream of the Denver Water diversions on McQueary, Bobtail, and Steelman creeks, brook trout are the dominant fish species. Data were not available for Jones Creek, but this stream probably also contains brook trout. Habitat simulation data are not available for these streams. It is believed that on Bobtail Creek, flows less than 1 cfs would not be sufficient to fully maintain fish and invertebrates, which is probably also true for the other tributaries. The low flows in winter in all four streams at a point downstream of their diversions are less than 1 cfs with Full Use of the Existing System and probably represent the most stressful period for the aquatic resources of these tributaries. These four streams have no bypass flows and are fully diverted at times. However, similar to the Fraser River tributaries, these streams resume flow downstream of the diversions from groundwater, tributaries, and wetlands during times when they are fully diverted.

The flow reductions during runoff with the Proposed Action would have a minor adverse impact on the fish and invertebrate populations in McQueary, Jones, Bobtail, and Steelman creeks. Although there would be no change in the critical winter flows, the Proposed Action would reduce the flow passing the diversions in wet months and extend the period when these streams are fully diverted.

Williams Fork Reservoir

The operation of Williams Fork Reservoir would be similar to Full Use with the Proposed Action. There would be a negligible impact with the Proposed Action.

Colorado River

Changes in the annual hydrology of the Colorado River for the Proposed Action would be less than 6% in average years and 4% in wet years. The changes would be less than 5% in almost all months. The only changes more than 10% would be 13% (83 cfs) reductions in June flows in average years below the Windy Gap diversion. Near Kremmling, the differences in flows would be 2% less on an annual basis in both average and wet years and 6% (127 cfs) or less in all months in all years. There would be no changes in water quality, riparian vegetation, or long-term channel morphology that would affect fish and invertebrates in the Colorado River. Increases in water temperatures would be negligible. Flows would be sufficient throughout the two segments of the Colorado River to continue to mobilize sediment and the channel bed. Therefore, there would be no long-term increase in habitat for the *T. tubifex* that carry whirling disease. Water temperatures are expected to be similar to existing conditions on most days. Overall, the Proposed Action would not have an effect on whirling disease in the Colorado River. Adequate flood flows and the similarity in base flows indicate that the Proposed Action would have no effect on Didymo as well. The Proposed Action would not change the current system of diversions and canals and would not introduce any new pathways for nuisance species distribution.

Habitat availability analyses indicate that the Proposed Action will have minimal effect on brown and rainbow trout in the Colorado River. Most of the changes in habitat would be minimal and most of the larger changes would result in higher habitat availability. There would also be minimal changes in channel morphology and water temperatures. As a result, the Proposed Action could have a negligible impact on aquatic resources in the Colorado River.

Blue River

Four segments were evaluated on the Blue River—the Dillon River Outlet (Segment 1, Dillon Reservoir to Rock Creek), Blue River below Boulder Creek (Segment 2, Rock Creek to Green Mountain Reservoir), Segment 3 from Green Mountain Reservoir to Spring Creek, and Segment 4 from Spring Creek to the confluence with the Colorado River. Habitat data were available for all life stages of brown trout in all four segments of the Blue River; habitat data were available for all life stages of rainbow trout in Segments 2 through 4. There would be no changes in water quality, riparian vegetation, or long-term channel morphology that would have an impact on aquatic resources.

The Proposed Action would result in similar flow as Full Use of the Existing System in most months in the Blue River. In Segment 1, there would be slight increases and decreases of less than 10% for all months in average years except for a 10% (25 cfs) lower flow in July. In wet years, there would be 27% (18 cfs) lower flow in October and 12% (6 cfs) higher flow in January. In Segments 2 through 4, the relative proportions of the changes would be lower, with no changes greater than 10% in average years and only a 15% reduction in flow in October of wet years. There would be no changes greater than 2% (2 cfs) in dry years in these segments. The minimum flows in winter and maximum flows during runoff would not change by more than a few percent in these segments.

For brown trout, minimum habitat availability for Full Use of the Existing System and the Proposed Action occurs in June during runoff for adults, fry, and juveniles. Due to the similarity in maximum flows for the Proposed Action and Full Use of the Existing System, changes to the minimum habitat availability for brown trout would be less than 1% for all life stages and all year types.

Minimum habitat availability for adult, juvenile, and fry rainbow trout occurs in summer months in the Blue River. Changes to habitat availability with the Proposed Action would be 2% or less for all life stages and all year types.

The minimal changes in habitat availability for brown and rainbow trout indicate that the Proposed Action would have a negligible impact compared to Full Use of the Existing System in the Blue River. For benthic invertebrates, the similarity in winter low flows and peak runoff flows indicates that there would be a negligible impact with the Proposed Action.

South Boulder Creek

Three segments of South Boulder Creek were available for habitat simulation. Segments 1 and 2 include the stream between Moffat Tunnel and Gross Reservoir. There would be no changes in water quality, riparian vegetation, or channel morphology that would affect the suitability of South Boulder Creek to support fish and invertebrates.

In Segments 1 (Moffat Tunnel to Pinecliffe) and 2 (Pinecliffe to Gross Reservoir), the Proposed Action would result in higher mean monthly flows on average in the runoff period and similar flows to Full Use of the Existing System in other months. In average years, the average monthly flows in June and July would be 10 to 22% (up to 106 cfs) higher in Segments 1 and 2 with the Proposed Action. In wet years, average flows would be 5 to 52% (up to 153 cfs) higher. There would be no differences in flows in dry years.

Habitat simulation data were available for adult and spawning life stages of brook trout in Segment 1; and for adult, juvenile, and fry rainbow trout in Segments 1 and 2. Habitat availability is lowest during runoff for brook and rainbow trout in average and wet years. In dry years, habitat availability is lowest during winter low flows and during runoff.

With the higher mean monthly flows during runoff with the Proposed Action, brook trout minimum habitat availability for adults would be similar to Full Use of the Existing System in average years and would decrease 13% in average years and 11% in wet years in Segment 1 of South Boulder Creek. Minimum brook trout spawning habitat availability would remain unchanged in average, wet, and dry years. For rainbow trout in Segment 1, reductions to minimum habitat availability would be 13% for adults and 18% for fry in wet years. Changes would be less than 10% for all other life stages of rainbow trout in Segment 1 and for all life stages and average, wet, and dry years in Segment 2.

There would be mostly minimal changes in trout habitat availability. However, there would be increased bank instability in Segments 1 and 2 of South Boulder Creek, which could alter habitat somewhat. The increases in runoff flows could have an effect on benthic invertebrate populations as well. The Proposed Action would result in a minor adverse impact and could result in decreased density of macroinvertebrates, or macroinvertebrate community composition could shift towards species that prefer fast-moving water.

Segment 3 extends downstream from Gross Reservoir to the South Boulder Diversion Canal and hydrology was available at the Gross Reservoir outflow. With Full Use of the Existing System, mean monthly flows in this segment of the stream are as high as 459 cfs in June and as low as 10 cfs in January and February of average years. With the Proposed Action, flows in average, wet, and dry years would be substantially different. In the winter months, flows would be 7 to 10 times higher (up to 88 cfs) and during runoff would be up to 23% (64 cfs) lower in average years. Both of these differences would tend to provide more favorable conditions for fish and invertebrates.

With Full Use of the Existing System, the minimum habitat availability for rainbow trout adults and juveniles occurs in the late winter and during the peak runoff flow month of June. The decreases in runoff flows would increase habitat availability in June for adults by 31% in average years and 126% in dry years. In average years, fry and juvenile habitat availability would increase by 48 and 33%, respectively. In wet years, juvenile habitat availability would increase 11%. Water temperatures throughout the year are expected to be lower with the Proposed Action compared to Full Use of the Existing System conditions with the expansion of Gross Reservoir. Temperatures during the growing season for trout would be several degrees cooler and would be less favorable for growth. Cooler temperatures are expected throughout this segment downstream to the South Boulder Creek diversion as there is little warming of the water in this segment (refer to FEIS Section 5.2).

The increases in winter flows would result in large increases in rainbow trout habitat availability and the small decreases in spring runoff flows would decrease conditions that may be stressful to early life stages of this species. The higher winter flows would likely alleviate winter low flow habitat limitations. However, the cooler temperatures throughout the year would limit trout growth and survival and likely dampen the beneficial effects of greater habitat availability. Higher winter flows and reduced peak flows would also provide more uniform flow conditions for benthic invertebrates. With less dramatic drying of the stream in winter months, Segment 3 of South Boulder Creek may support a higher density of macroinvertebrates. The increases in habitat availability for rainbow trout and macroinvertebrates indicate that the Proposed Action would have a minor beneficial impact on aquatic resources in Segment 3 of South Boulder Creek.

North Fork South Platte River

There were two segments of the North Fork South Platte River with habitat simulations. In Segment 1 (Roberts Tunnel to Buffalo Creek), hydrology from the North Fork South Platte River below Geneva Creek gage was used. In Segment 2 (Buffalo Creek to South Platte River) hydrology from the North Fork South Platte River above Pine. Habitat simulation data were available for all

four life stages of brown trout in both segments. There would be no changes to water quality, riparian vegetation, or channel morphology in the North Fork South Platte River that would affect aquatic resources. However, lower flows through Roberts Tunnel in winter would result in increases in concentrations of some metals compared to Full Use of the Existing System. Copper concentrations already exceed standards in the North Fork South Platte River upstream of the Roberts Tunnel and the reduced dilution of water with lower concentrations from the tunnel would extend the exceedances downstream of the tunnel as well.

The Proposed Action would result in many differences in flow compared to Full Use of the Existing System. Although the average annual flow would increase only 3% in average years and would decrease 2% in wet years, the timing of the flows would change considerably. Mean monthly flows would be up to 37% (37 cfs) lower in winter months and up to 29% (62 cfs) during the runoff period in Segments 1 and 2 in average, wet, and dry years. Under Full Use of the Existing System, minimum habitat availability occurs during runoff in June for adult, fry, and juvenile brown trout. The changes in flow with the Proposed Action would tend to be unfavorable to trout habitat availability. However, the daily peak flows would not change to the same degree and would not result in much change in habitat availability in average years.

In Segment 1, minimum habitat availability would decrease by only 2 to 9% in average years for all four life stages of brown trout. There would be decreases of 12%, 15%, and 10% for adults, fry, and juveniles, respectively in dry years and little change in wet years. In Segment 2, minimum habitat availability for spawning brown trout would decrease by 18%, 24% and 36% in average, dry, and wet years, respectively. For juveniles, habitat would also decrease 12% in dry years. There would be negligible changes in habitat availability for other life stages.

In both segments of the North Fork South Platte River, the slight increases in daily flows during runoff would result in some decreases in available habitat for brown trout with the Proposed Action. Concentrations of some metals, especially copper, would be higher in winter with reduced flows from Roberts Tunnel. The Proposed Action would have a minor impact compared to Full Use of the Existing System. The increases in flows during runoff indicate that there would also be adverse impacts to benthic invertebrate populations. For fish and invertebrates, the higher runoff flows and increased concentrations of some metals may result in lower density. Species richness may also decline.

South Platte River

Flow changes to the South Platte River upstream of the North Fork would be minor. There would be no impact to aquatic resources to the river or the reservoirs in this section. The small changes in hydrology in the segments of the South Platte River between the North Fork and Chatfield Reservoir likely will have a negligible impact to aquatic resources.

Habitat simulations are available for brown and rainbow trout for the South Plate River between Strontia Springs and Chatfield reservoirs. The Proposed Action would result in minimal changes in habitat availability for most life stages of brown and rainbow trout.

One segment was simulated for the coldwater section of the South Platte River downstream of Chatfield Reservoir. Habitat simulation data were available for four life stages of rainbow trout. Rainbow trout populations are maintained by stocking in this segment and changes in habitat availability, especially for the spawning life stage, may not affect fish populations as directly as in sections of the Project area with self-sustaining populations of trout. Therefore, the habitat analysis for this segment of the South Platte River incorporated an evaluation intended to apply to the broad range of species that are present in this segment. There would be no changes to water quality, water

temperature, riparian vegetation, or channel morphology that would affect fish and invertebrates in this segment of the South Platte River.

The hydrology in this segment of the South Platte River under the Proposed Action would include increases in mean monthly flow during the winter months in average, wet, and dry years by up to 30% (9 cfs). In dry years, flows during May, June, and July would decrease by 10 to 15% (up to 4 cfs). However, daily flow data do not indicate changes of the same magnitude. Changes in peak high and low daily flows would be less than for the monthly flows.

Minimum habitat availability with Full Use of the Existing System occurs during the low flow winter period for adult rainbow trout. Flows in this segment of the river are commonly very low throughout the winter of average, wet, and dry years. With Full Use of the Existing System, minimum habitat availability for most fish species and invertebrates probably occurs during the winter. The slightly higher daily flows in the winter under the Proposed Action would increase rainbow trout adult habitat availability 2% in average years. In dry years, habitat availability for adult and juvenile rainbow trout would be many times more with the Proposed Action compared to the very low levels with Full Use of the Existing System. The only slightly more favorable winter flows with the Proposed Action would result in minor beneficial impacts to the fish and invertebrate communities in the South Platte River compared to Full Use of the Existing System.

5.2.3 Alternative 1c

Gross Reservoir

The enlargement of Gross Reservoir would provide more habitat for fish and invertebrates. The final size of the reservoir would be approximately 651 surface acres, 53% larger than the existing reservoir. This would be a moderate beneficial impact to the reservoir fishery for Alternative 1c compared to Full Use of the Existing System. The beneficial impact would be slightly less than for the Proposed Action, which would result in Gross Reservoir being enlarged to 842 surface acres with the Environmental Pool.

Leyden Gulch Reservoir Site

With Alternative 1c, Leyden Gulch Reservoir would be created. This would represent a gain of 323 surface acres of reservoir habitat available for fish, invertebrates, and other aquatic organisms, a major beneficial impact. The reservoir fishery would not be managed and would probably include only a few fish species, with no recreational fishery.

The creation of the reservoir would inundate portions of Leyden Gulch. This stream is ephemeral in this section and does not support aquatic life. A small spring pool on a south branch of Leyden Gulch would also be inundated. This pool supports a limited community of aquatic organisms. The inundation of this pool would represent a minor adverse impact of Alternative 1c.

River Segments

Impacts to all river segments with Alternative 1c would be similar to those described in the Proposed Action.

5.2.4 Alternative 8a

Gross Reservoir

The enlargement of Gross Reservoir would provide more habitat for fish and invertebrates. The final size of the reservoir would be approximately 712 surface acres, 70% larger than the existing

reservoir. This would be a moderate beneficial impact to the reservoir fishery for Alternative 8a compared to Full Use of the Existing System. The beneficial impact would be slightly less than for the Proposed Action, which would result in Gross Reservoir being enlarged to 842 surface acres with the Environmental Pool.

South Platte River Facilities

Alternative 8a would include approximately 5,000 AF of storage capacity in reclaimed gravel pits adjacent to the South Platte River. The pits would typically fill with reusable effluent from November through April, when unused reusable effluent is available. Filling and operating the gravel pit reservoirs would provide aquatic resources with approximately 5,000 AF of open water habitat (approximately 200 surface acres). Over time, this habitat would likely be colonized by aquatic invertebrates and fish, which would represent a moderate beneficial impact of Alternative 8a.

The diversion structure for filling the gravel pit reservoirs would include a buried pipe connected from the South Platte River to a gravel pit. Direct minor adverse impacts to aquatic resources from construction of the diversion would include temporary disturbance in the South Platte River for the duration of construction.

Conduit O

Conduit O would cross several streams, including the South Platte River, containing communities of warmwater fish and invertebrates. Crossing the streams would be open cut per Denver Water's standard practice. Each crossing would be completed in approximately 20 working days, depending on weather and other conditions. Therefore, minor direct adverse impacts to aquatic resources from construction would include temporary disturbance for the duration of construction.

River Segments

Impacts to all river segments with Alternative 8a would be similar to those described for the Proposed Action.

5.2.5 Alternative 10a

Gross Reservoir

Impacts to fish and invertebrate communities would be the same as described under Alternative 8a.

Denver Basin Aquifer Facilities

The proposed distribution pipelines would cross four streams, including the South Platte River, containing communities of warmwater fish and invertebrates. The types of temporary impacts would be similar to those described for Conduit O described under Alternative 8a.

Conduit M

The alignment for Conduit M is the same for Conduit O between the Moffat Collection System delivery point and the intersection of 80th Avenue and Pierce Street. Streams crossed include Little Dry Creek, Clear Creek, and the South Platte River. The temporary direct minor adverse impacts of construction activities for Conduit M under Alternative 10a on aquatic biological resources in these streams would be the same as described for Conduit O under Alternative 8a.

River Segments

Impacts to all river segments with Alternative 10a would be similar to those described for the Proposed Action.

5.2.6 Alternative 13a

Gross Reservoir

The enlargement of Gross Reservoir would provide more habitat for fish and invertebrates. The final size of the reservoir would be approximately 755 surface acres. This would be a moderate beneficial impact to the reservoir fishery for Alternative 13a compared to Full Use of the Existing System. The beneficial impact would be slightly less than for the Proposed Action, which would result in Gross Reservoir being enlarged to 842 surface acres with the Environmental Pool.

South Platte River Facilities

The beneficial impacts from gravel pit storage would be similar to those described under Alternative 8a, except that only 3,625 AF (approximately 200 acres) of open water habitat would be created under Alternative 13a.

Additionally, the gravel pit pipeline would extend 5 miles to the northern Challenger Pit and would cross the South Platte River at Bridge Street. There would be temporary minor direct adverse impacts during construction at the crossing.

Conduit O

Impacts from construction of Conduit O would be the same as described for Alternative 8a.

River Segments

Impacts to all river segments with Alternative 13a would be similar to those described for the Proposed Action.

5.3 OTHER WILDLIFE (230.32)

Section 5.9 of the Moffat Project FEIS describes impacts to other wildlife such as big game species; carnivores and small- and medium-sized mammals; raptors and other birds; and reptiles and amphibians.

5.3.1 No Action Alternative

The No Action Alternative (i.e., both the Depletion of the Strategic Water Reserve and the Combination strategies) would not result in any direct effects to habitat because no ground-disturbing Project components would be implemented. Changes in operation of the existing system would result in changes in stream flows, which would result in only minor changes in the extent and type of riparian habitat present in the Project area (Section 5.8 of the Moffat Project FEIS). Therefore, implementation of the No Action Alternative would result in minimal effects on wildlife habitat or species.

5.3.2 Proposed Action

Gross Reservoir

Wildlife present in the Gross Reservoir study area include big game and other mammals, raptors, migratory birds, reptiles and amphibians and fish (refer to FEIS Section 3.11 for description of aquatic resources). Wildlife habitat in the Gross Reservoir study area that would be impacted by reservoir expansion include ponderosa pine woodland, ponderosa pine/Douglas-fir woodland, mountain grassland, talus slopes/rock outcrops, open water, and disturbed or unvegetated areas (Section 5.9 of the Moffat Project FEIS). Most of the impacts would occur in ponderosa pine and ponderosa pine/Douglas fir woodlands. Disturbed/unvegetated areas, while not high quality wildlife habitat, do provide movement corridors and relatively contiguous habitat and, therefore, are included in the impact analysis. Small areas of wetland and riparian vegetation would also be affected (Section 5.8 of the FEIS). Direct impacts to wildlife would result from loss or degradation of habitat, mortality from ground-disturbing activities, and from vegetation clearing and inundation of natural habitat. Indirect impacts consist of displacement of wildlife by noise and disturbance resulting from on-site construction, quarrying, and transport of materials and people.

Big Game

Big game, including mule deer, elk, mountain lion, and black bear, would lose habitat because of permanent and temporary losses of habitat during construction and reservoir enlargement. The Proposed Action would have the greatest impacts to big game habitats of all of the action alternatives, but the amounts of lost habitat would not alter general patterns of habitat use or behavior of these species.

Mule deer, mountain lion, and black bear occur at Gross Reservoir year-round. Direct losses of habitat would include 465.1 acres of permanent impacts and 89.3 acres of temporary impacts. Mule deer herds inhabiting the Gross Reservoir study area would not likely be adversely affected by the reservoir enlargement because no crucial seasonal habitats are present and the affected area represents a very small part of the habitat available to the herd. Impacts to mountain lion and black bear habitat would be minimal because the impacted area represents only a small portion of the typical home range occupied by individuals of these species. In addition, mountain lions prey mostly on mule deer and their prey base is not expected to be reduced.

Elk are present in the area during the winter, and three types of crucial seasonal habitats are present: elk migration corridor, severe winter range, and winter concentration areas. Severe winter range and winter concentration areas are separate categories that overlap in some areas and cannot be added together to derive a total area of elk impact. Elk migration corridors and severe winter range are separate categories, but all of the construction and operation impacts would occur in both habitats.

The loss of 321 acres of elk winter concentration represents approximately 3.4% of this habitat currently available to this herd within 3 miles from the reservoir shoreline, of which about 0.5% would be temporary. Similarly, less than 2% of severe winter range (291 acres) within 3 miles would be lost due to reservoir expansion, of which about 0.3% would be temporary impacts to severe winter range. The land within 3 miles of the reservoir is only a very small proportion of the habitat available to the Clear Creek elk herd and, therefore, reservoir expansion under the Proposed Action would not likely have long-term impacts to the elk herd and is considered a moderate impact.

The direct loss of elk winter concentration areas represents about 1.3% of this habitat in the map unit, of which 0.2% would be temporary impacts. The loss of severe winter range represents 1.8%

of this habitat in the affected map unit, of which 0.3% would be temporary impacts. Impacts would be less than 1% to these habitats across the entire herd unit, a minor impact. About 7.0% of the migration corridor would be lost due to the Proposed Action, of which about 1.1% would be temporary impact. Permanent loss of portions of the migration corridor would likely cause changes in elk migration patterns, as described below.

Year-round construction activities at the dam and nearby areas would displace big game from the eastern side of the reservoir. Operation of the quarry would contribute to displacement although Denver Water would use confined charge blasting to reduce noise. The distance that animals move to avoid human disturbance is dependent on the species and/or individual, topography, vegetation cover, and intensity of the disturbance. The amount of displacement is difficult to estimate, but is likely to be ¼ to ½ mile or more, involving hundreds of acres adjacent to the construction areas on the east side of the reservoir and areas along the western shore facing the dam and quarry. Displacement is not likely to affect use of most of the Winiger Ridge area. Construction would occur year-round, including the winter when the area would normally be used as elk winter range, concentration area, and severe winter range. This displacement would occur each winter during the construction period for four years. During operation, big game are unlikely to exhibit any changes in behavior from Current Conditions (2006).

The only construction activities on the western, northern, and southern sides of the reservoir would be clearing and disposal of woody vegetation from the new reservoir footprint. This activity would also displace big game, but would occur mostly during the summer and fall. Clearing and disposal of trees is expected to take 6 to 8 months and is unlikely to affect wintering elk. Activities in the dam area are unlikely to cause displacement of big game from the west side of the reservoir because of the distance from construction disturbance.

Gross Reservoir is near the eastern end of a migration corridor that extends from elk summer concentration areas west of Nederland to winter concentration areas around and north of the reservoir. About 7.0% of the migration corridor would be lost due to the Proposed Action, of which about 1.1% would be temporary impact. Permanent loss of portions of the migration corridor would likely cause changes in elk migration patterns, and would be a moderate impact. The migration corridor extends around the reservoir, including the north and south shores (Figure 3.9-2 in Chapter 3 of the Moffat Project FEIS). Construction activities on the east side the reservoir could affect movement of elk near the reservoir and displace them to adjacent areas, but movement on the west side of the reservoir and most of the corridor is unlikely to be affected. During operation, the expanded reservoir would back up water in South Boulder Creek and other tributaries and would create greater obstacles for movement. Under the Proposed Action, approximately 2,495 feet of South Boulder Creek and approximately 2,160 feet of Winiger Gulch would be inundated. Inundation of these streams is likely to result in changes in movement for elk and deer. Inundation of South Boulder Creek above the reservoir could affect movement of elk and deer near Pinecliffe, because the canyon between the enlarged reservoir and Pinecliffe is narrow and steep and may be difficult to cross. The new reservoir arms would be relatively narrow and big game may continue to cross them especially in the spring when the reservoir would be at a lower elevation. Loss of habitat and potential change of use patterns may force elk and deer to adjacent private lands, which could increase CPW obligations for game damage compensation. Management of nuisance wildlife issues and public safety is a CPW priority (CDNR 2010). Hunting is a primary tool for managing herd size, but closure of areas in Boulder County near Gross Reservoir to hunting makes it more difficult to achieve adequate harvest of big game.

Other short-term, direct impacts to big game would occur from potential collisions with haul trucks and other vehicles along access routes including County Road 77S, and SHs 72, 93, and 128 due to the increase in traffic from construction. Approximately 202 construction worker vehicle trips and

44 to 74 supply delivery trips would occur per day, as described in Section 5.12 of the FEIS. The increase in traffic on County Road 77S may result in an increase in collisions with big game and other wildlife, but are not likely to adversely affect local populations. As shown on Figure 3.9-1 in Chapter 3 of the Moffat Project FEIS, Mule Deer Habitat, portions of SHs 72 and 93 that are potential haul routes for construction of the Gross Reservoir expansion are frequently crossed by mule deer. These areas are used year-round by mule deer. Although they are a safety concern, collisions would have a negligible effect on big game populations.

Carnivores and Small- and Medium-sized Mammals

Direct impacts to small- and medium-sized mammals include habitat loss and mortality from ground-disturbing construction activity. Small-bodied animals in the immediate area of construction activity may be killed by crushing or burying during construction. More mobile species, including medium-sized animals, could avoid the construction zones, but would be temporarily displaced by construction. Temporary displacement could result in increased mortality from vehicle collisions and increased resource competition.

As discussed under Big Game, the increased water level up the fingers at Winiger Gulch and South Boulder Creek would create a barrier to movement for these species, especially smaller-sized mammals that would have to travel long distances to move around the water. The indirect impacts of the enlarged reservoir to small- and medium-sized mammals would be fragmentation of habitat.

Numerous bats inhabit the mixed conifer and ponderosa pine woodlands in the Gross Reservoir study area. The primary impacts to these species would be loss of roosting trees around the perimeter of the reservoir and disturbance to roosting bats during construction and vegetation-clearing activities. The enlarged reservoir would create additional open water foraging habitat for some bat species.

Raptors

Although no raptor nests were observed during field surveys, several species may nest in the vicinity of the reservoir and could be affected by construction. Clearing of vegetation during reservoir site preparation has the potential to remove trees with stick nests used by hawks or cavity nests used by owls. The Project does not involve construction on cliffs and is very unlikely to affect cliff nesting species such as falcons and is not expected to affect the osprey nesting platforms at Gross Reservoir.

Direct impacts could occur during construction from disturbance from human activity around an active raptor nest. Depending on several factors such as species, the type of activity, topography, and individual sensitivity, disturbance could result in loss of eggs or young from nest abandonment. CPW has recommended buffer zones and seasonal restrictions that range from 0.25 to 0.5 mile for nests of various raptor species including golden eagle, red-tailed hawk, osprey, and northern goshawk (CDOW 2008). In addition to buffers and seasonal restrictions for human encroachment, CPW recommendations generally include no surface occupancy (no new structures) within buffer zones. The CPW recommendations do not address some species that may occur, including owls, sharp-shinned hawk, and Cooper's hawk. If raptor nests are discovered during raptor surveys, seasonal buffers would be established and coordinated with CPW to avoid or minimize impacts to nesting raptors.

Loss of habitat from inundation would be limited to a strip about 150-300 feet wide along most of the reservoir perimeter under the Proposed Action and would be less under other action alternatives (see Figure 2-3 in Chapter 2 of the Moffat Project FEIS). Most of the affected area is forest or woodland, and loss of habitat would reduce foraging habitat both for forest birds and for species that forage in ponderosa pine woodlands. There would be increases in open water and shoreline habitat.

The Proposed Action is not expected to adversely affect populations of sensitive raptor species such as northern goshawk and flammulated owl, as discussed in Section 5.10 of the FEIS.

Other Birds

Direct impacts to other birds would consist of loss of habitat from vegetation clearing and inundation, as well as disturbance during construction activities. Birds primarily affected by vegetation clearing include species that inhabit ponderosa pine and ponderosa pine/Douglas fir woodland habitats. The Gross Reservoir Dam and other facility construction would occur primarily between May and September, which would likely result in impacts to migratory birds. In the Moffat Project FWMP, which has been approved by the Colorado Wildlife Commission, Denver Water has committed to the use of pre-construction surveys to identify active nests in the Project footprint and timing of activities to avoid the breeding season.

Operation of the enlarged reservoir would benefit waterfowl due to the increased surface area of the water body. Under the Proposed Action, the reservoir expansion would provide an additional 400 acres of open water habitat, depending on water level, for waterfowl to forage. Shorebirds, such as spotted sandpiper, may utilize the shoreline for foraging. Nesting habitat along the shoreline for waterfowl and other birds would be limited due to the fluctuating water levels.

Reptiles and Amphibians

Since most of the reptile and amphibian species occur in riparian habitats, the primary impact to these species would be crushing or burial from earth-moving equipment during construction. At areas such as South Boulder Creek and Winiger Gulch, the inlets into the reservoir would be inundated, resulting in loss of habitat. Reptiles and amphibians would be able to move to avoid inundation during reservoir filling. After reservoir expansion, the fluctuating water levels would make creation of new riparian/wetland habitat unlikely except at creek inlets.

USFS Management Indicator Species

Construction and operation of Gross Reservoir would have negligible to moderate impacts to the various Management Indicator Species (MIS). Elk, mule deer, and black bear are discussed above under Big Game. There would be no impacts to Rocky Mountain bighorn sheep or boreal toad in the Gross Reservoir area. Impacts to special status species are discussed in FEIS Section 5.10 and Section 5.1 of this document. Impacts to brook and rainbow trout are discussed in FEIS Section 5.11. The remaining species include pygmy nuthatch, golden-crowned kinglet, hairy woodpecker, mountain bluebird, warbling vireo, and Wilson's warbler. Construction and operation will result in loss of habitat for these species, resulting in small decreases in regional populations.

A technical report was prepared in response to comments and data requests from the USFS on the Moffat Project DEIS (refer to Appendix G-3 in the Moffat Project FEIS). More specifically, the report addresses USFS Region 2 sensitive animal and plant species and plant species and communities of local concern in the ARNF.

Sensitive Areas

Potential Conservation Areas (PCAs) identified by Colorado Natural Heritage Program (CNHP) and Environmental Conservation Areas (ECAs) identified by Boulder County are shown on Figure 3.9-3 in Chapter 3 of the Moffat Project FEIS and would be directly impacted by vegetation removal and inundation around the perimeter of the reservoir. These sites are those considered important for protection by CNHP and Boulder County. Table 3 lists impacted acreage to sensitive areas by alternative.

Under the Proposed Action, direct impact to the Winiger Gulch PCA includes inundation of 71.8 acres (3.8% of total PCA area) and the Winiger Ridge ECA would lose 243.4 acres (7%) to inundation. Two rare plant communities occur in the PCA and would be affected. The Hawkin Gulch/Walker Ranch/upper Eldorado Canyon ECA, located below the dam, would not incur impact under the Proposed Action or any other action alternatives.

Table 3
Direct Impacts to Sensitive Areas by Alternative

		Impact by Alternative (acres)									
		Proposed Action (Alternative 1a)		Alternative 1c		Alternative 8a		Alternative 10a		Alternative 13a	
Type	**Sensitive Area**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**
PCAs	Winiger Gulch	71.8	--	42.0	--	53.1	--	53.1	--	61.6	--
	Rocky Flats	--	--	--	2.6	--	--	--	--	--	--
	South Platte River	--	--	--	--	5.6	9.6	6.1	9.4	5.1	9.4
ECAs	Winiger Ridge	243.4	--	144.2	--	180.6	--	180.6	--	211.8	--
Other	South Platte River Greenway	--	--	--	--	<0.1	1.4	0.3	2.4	0.1	2.4
Total		**315.2**	**--**	**186.2**	**2.6**	**239.3**	**11**	**240.1**	**11.8**	**278.6**	**11.8**

Notes:
The calculation of the noted acres assumes disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the expanded reservoir of the Environmental Pool for mitigation (elevation 7,406 feet).
ECA = Environmental Conservation Area PCA = Potential Conservation Area
P = permanent T = temporary

River Segments

The Moffat Project does not include any construction activities along the river segments, and the analysis of impacts is therefore focused on effects to habitat that may result from changes in stream flows. The conclusions in this section are based on more detailed analysis in Section 5.8 (riparian and wetland habitats) and Section 5.4 (groundwater). Hydrologic impacts are based on a comparison of Full Use of the Existing System and Full Use with a Project Alternative (2032).

Wetland and riparian habitats occur in areas of greater moisture provided by complex interactions between stream flows, groundwater, precipitation, and the physical characteristics of the stream channel and its floodplain. The riparian/wetland analysis focused on two primary mechanisms that may affect riparian vegetation, lowering of groundwater tables to a degree that causes plant mortality and changes in the width regularly inundated by stream flows. The Proposed Action is designed to capture surface water flows only during periods of higher runoff in wet or average years, and increased diversions would generally not occur in dry years or during periods of low flows. Flow modifications resulting from the Proposed Action are within the range of normal variability, and flows already vary substantially from dry year to wet year and over the course of a season.

The groundwater analysis in Section 5.4 of the FEIS indicates that flow changes along the river segments would cause localized, minimal effects to the water table that would not be any larger than stream elevation changes and would be well within the range of normal seasonal fluctuations. The small changes in the water table may cause a slight trend toward reduction in wetland species and increase in upland or facultative species on the banks, but effects are expected to be minimal. Given the small amount of change and complexity of riparian areas, changes are likely to be small in magnitude and patchy in distribution.

Modeling of impacts from stream flow changes is summarized in Section 5.8 of the FEIS. The analysis is based on detailed hydraulic and vegetation data collected at 12 sampling sites. The largest changes in the 2-year flows would be 8 inches or less in height, and up to 5 feet in width (FEIS Table 5.8-4). The area covered by 2-year flows would decrease in the Fraser River and its tributaries, Colorado River, Blue River, and South Boulder Creek below Gross Reservoir; and would increase in South Boulder Creek above Gross Reservoir and North Fork South Platte River, compared to Full Use of the Existing System. Decreases in the 2-year flow could result in a gradual narrowing of the stream banks, which would decrease hydrology for wetlands within the banks. However, longer term floods may remove accumulated sediment and reverse the narrowing. Where narrowing occurred, vegetation would respond by gradually adjusting its location, moving downgradient to remain in the same hydrological zone. Changes are likely to be very slow in most areas. The zone of reduced hydrology may show a change in composition to riparian species with somewhat lower water requirements, or upland species such as conifers. Wetlands and riparian areas that are maintained primarily by groundwater discharge would not be affected.

The analysis in Section 5.8 of the FEIS also addresses overbank flooding associated with 5- and 10-year flows. The area of overbank flooding would decrease in the Fraser River, Colorado River, Blue River, and South Boulder Creek below Gross Reservoir but changes would be relatively small, 1-8 inches in height, and 2-6 feet in width. These changes could reduce riparian vegetation density or productivity and cause change in composition including increases in upland species.

The analysis of changes to wetlands and riparian habitats in Section 5.8 of the FEIS characterizes changes to riparian and wetland habitats as minor or negligible in the various streams, with changes more likely to involve a shift in composition rather than a loss of habitat. These small changes could potentially affect food availability or cover for riparian wildlife species. Changes in habitat quality are likely to be small and patchy and relatively subtle in most places. These changes are not likely to affect overall distribution or populations of bird, mammal, reptile, and amphibian species.

Changes in stream flows in the Fraser River, Williams Fork, and their tributaries would have negligible effects on moose and elk distribution and population. Moose concentration areas include stream valleys below a number of the diversions, but also include upland areas between the drainages. Elk summer range occurs throughout the Fraser and Williams Fork valleys. Although some changes to riparian and wetland habitats could occur along the streams, the large wetlands and riparian complexes appear to be primarily supported by groundwater and are unlikely to be affected.

Two USFS MIS species occur along the Fraser and Williams Fork rivers and their tributaries, Wilson's warbler, and boreal toad. Boreal toad is a special status species that would have negligible effects from the Proposed Action. It is discussed in more detail in Section 5.10 of the FEIS. Wilson's warbler is an indicator for montane riparian and wetland habitat, is known to occur and is likely to be common in suitable habitat along all of the streams in the Fraser and Williams Fork valleys. Wilson's warblers nest and forage in and near montane and subalpine riparian shrub and wet meadows (Kingery 1998; Johnson and Henderson 2003). The availability of suitable habitat appears to be a limiting factor for Wilson's warbler populations, and dewatering of riparian habitats is one of the primary threats to this species (Johnson and Henderson 2003). As discussed in Section 5.8 of the FEIS, the Proposed Action would have negligible to minor impacts to riparian vegetation along the Fraser River, Williams Fork, and their tributaries. These changes may affect Wilson's warbler locally, but are not likely to result in adverse effects to overall distribution or population.

The Proposed Action would have no or negligible effects to PCAs and State Wildlife Areas that occur downstream of the diversions. In the Fraser Valley, the riparian habitats in the PCAs are partly supported by the diverted streams but also receive water from other streams and/or

groundwater discharge. The South Fork Williams Fork includes part of the mainstem of the Williams Fork, where diversions are expected to have no or negligible effects to riparian habitats. The upper Williams Fork PCA was designated because of occurrences of Colorado River cutthroat trout and boreal toad. As described in Section 5.10 of the FEIS, the Proposed Action would have no or negligible effect on boreal toad and to conservation populations of Colorado River cutthroat trout above the diversions. Changes in Colorado River and Blue River riparian habitats are expected to be negligible. South Boulder Creek east of Gross Reservoir flows through the Hawkin Gulch/ Walker Ranch/upper Eldorado Canyon ECA and the Boulder Foothills PCA, but flow changes would not affect the resources for which these areas were identified.

5.3.3 Alternative 1c

Gross Reservoir

Impacts to wildlife under Alternative 1c would be similar to those described under the Proposed Action, but would affect less area. Alternative 1c would result in a smaller reservoir enlargement (40,700 AF). Impacts to wildlife would be similar to the Proposed Action, although less habitat would be removed under Alternative 1c. The enlarged reservoir would still result in loss and fragmentation of habitat, as described under the Proposed Action. In riparian areas such as Winiger Gulch and South Boulder Creek, Alternative 1c would result in slightly less fragmentation because the water level would be lower. Approximately 2,100 feet of South Boulder Creek and approximately 1,370 linear feet of Winiger Gulch would become inundated and impassable for wildlife.

The loss of elk winter concentration areas (229.8 acres, FEIS Table 5.9-2) represents approximately 0.9% of this habitat in the map unit; about 0.25% of this loss would be temporary. Approximately 1.3% of elk severe winter range in the map unit would be lost due to reservoir expansion; of which about 0.3% would be temporary impact to severe winter range. Direct losses of habitat would be less than the Proposed Action, and would be less than 1% of the habitat available to the Clear Creek elk herd, a minor impact. About 5.2% of the migration corridor would be lost due to the Proposed Action, of which about 1.2% would be temporary impact. Permanent loss of portions of the migration corridor would likely cause changes in elk migration patterns, as described for the Proposed Action. Alternative 1c would affect about 406 acres of mule deer summer range, which would have a minor effect on the mule deer herd.

Alternative 1c would affect smaller amounts of USFS wildlife habitats at Gross Reservoir than the Proposed Action (FEIS Table 5.9-3), including existing old growth, developing old growth, forested corridors, open corridors, effective habitat, and interior forests. As with the Proposed Action, losses of inventoried and developing old growth and reductions in effective habitat may be in conflict with ARNF management goals. Losses of forested and open corridor would occur adjacent to the existing reservoir and would not cause a reduction in connectedness.

Alternative 1c impacts to MIS species at Gross Reservoir would be similar to the Proposed Action; Alternative 1c would have a smaller footprint and would affect a smaller amount of habitat for each of the species. In addition to elk and mule deer, described above, Alternative 1c would affect about 133 acres of pygmy nuthatch habitat (existing and potential old growth), about 165 acres of hairy woodpecker habitat (forests), and about 35 acres of mountain bluebird habitat (openings). Impacts to these species would reduce local populations but would be minor on a regional basis. Alternative c would also remove about 4.4 acres of warbling vireo habitat, a negligible impact. Golden-crowned kinglet and Wilson's warbler are unlikely to breed in the Gross Reservoir study area, and loss of habitat is expected to have a negligible effect on migrating birds. There would be no impacts to Rocky Mountain bighorn sheep or boreal toad in the Gross Reservoir area.

Impacts to sensitive areas would be reduced compared to the Proposed Action. As shown in Table 5.9-3, the Winiger Gulch PCA at Gross Reservoir would be permanently impacted by reservoir filling resulting in 42.0 acres of impact at Gross Reservoir. Under Alternative 1c, 2.2% of the PCA area Winiger Gulch PCA would be lost to the expanded reservoir. The Winiger Ridge ECA would lose 144.2 acres (4.1%) to inundation.

Leyden Gulch Reservoir Site

Habitats affected by construction and operation of the proposed reservoir include grassland/forb mix, foothills deciduous shrub, wetlands, rural residential (deciduous trees and ornamental plantings), open water (South Boulder Diversion Canal), and disturbed/unvegetated. Most of the affected habitat is grass/forb mix. Vegetation temporarily disturbed or removed would be revegetated following construction.

The proposed Leyden Gulch Reservoir would be maintained more or less at capacity except in an extended drought, although the water levels would fluctuate during operation. At the normal water level of 6,124 feet, the reservoir would have a capacity of approximately 31,300 AF and the surface area would be 332 acres. Monthly average, dry, and wet end-of-month contents would be approximately 28,000 AF to 31,000 AF or up to 3,000 AF below capacity. The reservoir would be drawn down primarily in dry years. Annually, water levels would be highest from June to December, which would allow herbaceous wetland vegetation to establish around the shoreline. These wetlands would provide cover and habitat for wildlife, including nesting and foraging waterfowl. Over the long term, deciduous riparian woodland, such as cottonwoods and willows may establish in areas around the shoreline, which would support migratory birds, raptors, and small mammals. However, if noxious weeds become established in these areas, they could invade and degrade adjacent habitats, reducing the quality of habitat surrounding the reservoir for wildlife use.

Big Game

The primary impacts to big game are loss and fragmentation of habitat from reservoir construction. Construction of the reservoir would permanently remove approximately 383 acres of habitat for the dam and reservoir, and would temporarily affect 172 acres of big game habitat. Mule deer occur in the Leyden Gulch study area during both summer and winter, while elk are present during winter. Wintering elk and deer would experience more stress from habitat loss, because resources are more limited. However, creation of Leyden Gulch Reservoir would not measurably affect big game populations because no critical habitats would be affected.

After reservoir construction and filling, the 31,300 AF reservoir would prevent big game from directly moving east-west, although this area is not considered an important migratory corridor. Animals would be required to travel around the reservoir. In addition, the reservoir may be hazardous to big game when crossing thin ice or crossing over the ice when predators such as coyotes or mountain lions are present.

As described for Gross Reservoir under the Proposed Action, mule deer and other big game would likely be displaced from the area during construction.

Black bear primarily use the Ralston Creek corridor. Black bear would be temporarily displaced from this area during construction. Bears would likely return to the area following construction. Mountain lions would likely avoid the area during construction. Conflicts between humans and these animals would likely increase during operations due to the increased human presence in the area for reservoir operation and maintenance.

Carnivores and Small- and Medium-sized Mammals

Direct impacts to small- and medium-sized mammals would include loss and fragmentation of habitat, displacement, and mortality. The reservoir creates a barrier to movement and smaller bodied mammals would have to travel longer distances to find suitable habitat. Like big game, more mobile mammals would be displaced from the area during construction. Small mammals may be crushed or buried during earth-moving activities because these animals are less able to travel to avoid noise and ground disturbance.

Prairie dog colonies in the reservoir footprint are small and isolated, and are at the western boundary of the species range. Denver Water controls the prairie dogs within the reservoir Project area. Construction of the reservoir would remove 7.2 acres of black-tailed prairie dog colonies and eliminate approximately 380 acres of potential prairie dog habitat during reservoir construction and inundation. In addition to the mortality of prairie dogs, the proposed reservoir would eliminate habitat for numerous other species associated with prairie dog colonies.

Raptors

During field surveys, a red-tailed hawk nest was observed along Ralston Creek. Construction of the South Boulder Diversion Canal pipeline and associated staging would occur within 0.25 mile of the nest. A nest survey should be conducted prior to construction to determine numbers and locations of active raptor nests in the Project area, and construction should be avoided in the vicinity of action nests until chicks have fledged.

As mentioned above, the prairie dog colonies in the study area provide foraging habitat for raptors. The reservoir would permanently eliminate this habitat for raptors.

Other Birds

The primary impact to migratory birds would be loss of habitat from the reservoir and displacement during construction. After reservoir construction, the reservoir footprint and associated facilities would be unsuitable for most migratory land bird use during breeding, foraging, or migration. Some bird species that forage over open water, such as swallows, would benefit from the reservoir. Very few trees are present in the reservoir footprint, but nests may occur in these trees or on the ground. If vegetation clearing or construction occurs during the general nesting season (May through July), active nests may be destroyed.

Operation of the reservoir would be beneficial to waterfowl, shorebirds, and other water birds. The reservoir would provide an average of 332 acres of open water habitat, depending on water level. For waterfowl, the reservoir would provide resting and loafing areas and potential foraging habitat. Although the reservoir would not be stocked with fish, some rainbow trout, brown trout, and other species may enter the reservoir through the South Boulder Diversion Canal. These fish would provide a food source for piscivorous birds such as cormorants and herons.

Herbaceous vegetation is likely to become established along the shoreline since water elevations would generally remain stable during summer months. Over the long term, cottonwoods, willows, and herbaceous wetland vegetation may become established in some areas around the reservoir. Therefore, nesting habitat for waterfowl would develop along the shoreline in wetland vegetation. The shoreline would also be used by shorebirds, primarily those in migration.

Reptiles and Amphibians

Similar to impacts described for small mammals, less mobile reptiles and amphibians such as toads and frogs may be crushed or buried by construction equipment during vegetation clearing and ground disturbance. More mobile species such as snakes may be able to avoid construction

activities, although this would be unlikely due to the large area that would be disturbed. The new reservoir and shoreline would provide new habitat for some species of reptiles or amphibians because the stable water elevations during the summer would promote establishment of wetland herbaceous vegetation and riparian shrubs and trees around the perimeter.

Sensitive Areas

The CNHP-designated Rocky Flats PCA overlaps the northern portion of the Leyden Gulch study area (refer to Figure 3.7-3 in Chapter 3 of the Moffat Project FEIS). A 2.5-acre (less than 1%) portion of the PCA would be temporarily impacted for a 41-acre construction staging and spoil area located north of the reservoir. This area would store the excavated material from the reservoir pool area prior to the dam construction and earth-moving equipment would be entering and exiting the area. As stated in Section 2.4.2.2 of the FEIS, the staging area would be restored to its approximate existing condition following the completion of the reservoir. This would primarily impact habitat for migratory birds until revegetation is completed.

River Segments

Impacts would be similar to those described under the Proposed Action. Changes in flow and resulting changes in wildlife habitats would be the same or nearly the same, and would be negligible to minor along the various stream segments.

5.3.4 Alternative 8a

Gross Reservoir

Impacts to wildlife and wildlife habitat under Alternative 8a would be similar to those described under the Proposed Action, except less because Alternative 8a would result in only a 52,000 AF enlargement of Gross Reservoir. Impacts to wildlife would be similar to the Proposed Action, except less habitat would be removed under Alternative 8a. The enlarged reservoir would result in loss and fragmentation of habitat, as described under the Proposed Action. In riparian areas such as Winiger Gulch and Forsythe Gulch, Alternative 8a would result in slightly less fragmentation because the water level would be lower. Approximately 2,140 feet of South Boulder Creek and 1,780 feet of Winiger Gulch would become inundated and become a barrier for terrestrial wildlife.

The loss of elk winter concentration represents approximately 1.1% of the habitat in the map unit; 0.25% of this loss would be temporary. Approximately 1.5% of elk severe winter range in the map unit would be lost due to reservoir expansion; 0.3% would be temporary impact to severe winter range. Direct losses of habitat would be less than the Proposed Action, and would be less than 1% of the habitat available to the Clear Creek elk herd, a minor impact. About 5.9% of the migration corridor would be lost due to the Proposed Action, of which about 1.3% would be temporary impact. Permanent loss of portions of the migration corridor would likely cause changes in elk migration patterns, as described for the Proposed Action. Alternative 8a would affect about 461 acres of mule deer summer range, which would have a minor effect on the mule deer herd.

Alternative 8a would affect smaller amounts of USFS wildlife habitats at Gross Reservoir than the Proposed Action but more than Alternative 1c (FEIS Table 5.9-3). These habitats include existing old growth, developing old growth, forested corridors, open corridors, effective habitat, and interior forests. As with the Proposed Action, losses of inventoried and developing old growth and reductions in effective habitat may be in conflict with ARNF management goals. Losses of forested and open corridor would occur adjacent to the existing reservoir and would not cause a reduction in connectedness.

Alternative 8a impacts to MIS species at Gross Reservoir would be similar to the Proposed Action, although Alternative 8a would have a smaller footprint and would affect a smaller amount of habitat for each of the species. In addition to elk and mule deer, described above, Alternative 8a would affect about 159 acres of pygmy nuthatch habitat (existing and potential old growth), about 203 acres of hairy woodpecker habitat (forests), and about 39 acres of mountain bluebird habitat (openings). Impacts to these species would reduce local populations but would be minor on a regional basis. Alternative 8a would also remove about 4.9 acres of warbling vireo habitat, a negligible impact. Golden-crowned kinglet and Wilson's warbler are unlikely to breed in the Gross Reservoir study area, and loss of habitat is expected to have a negligible effect on migrating birds. There would be no impacts to Rocky Mountain bighorn sheep or boreal toad in the Gross Reservoir area.

Under Alternative 8a, direct impact to the Winiger Gulch PCA includes inundation of 7.8 acres (10.7% of total PCA area), while the South Boulder Creek above Gross Reservoir PCA would lose 15.4 acres (7.8%) to the reservoir. The Winiger Ridge ECA would lose 180.6 acres (5.1%) to inundation. About 32% of Winiger Gulch in the PCA would be affected (1,892 feet) and 26% of South Boulder Creek (2,224 feet).

South Platte River Facilities

Gravel Pits

The gravel pits have already been excavated; therefore, no additional ground disturbance would occur and no adverse impacts from gravel pit construction is expected. Filling and operating the gravel pit reservoirs would provide a beneficial impact to wildlife because approximately 5,000 AF (approximately 200 surface acres) of open water habitat would be created for waterfowl, shorebirds, migratory birds, and amphibians and reptiles. Areas that become vegetated along the shoreline may provide nesting habitat for mallards, geese, and red-winged blackbirds. Use of the gravel pits would not cause habitat fragmentation because they already exist and their location does not block movement along the South Platte River corridor.

Gravel Pit Pipelines

Impacts would primarily be limited to disturbance during construction as the pipeline would mostly be placed within existing road ROWs. Construction of pipelines would temporarily affect aquatic and upland habitat along the South Platte River.

Diversion Structure

The diversion structure includes a 750-foot buried 54-inch pipe connected to the southern gravel pit (Worthing Pit), which would be constructed in the South Platte River near the Worthing Pit. Impacts to wildlife from construction would include temporary disturbances during construction. The pipeline would follow an existing gravel road and construction staging would be temporary. A raptor nest was identified in the vicinity of the diversion structure in 2005. Surveys for raptor nests would be needed prior to construction to determine locations of active nests.

Advanced Water Treatment Plant

Construction of the AWTP adjacent to the Worthing Pit would result in permanent impacts to 4 acres and temporary disturbances to 7 acres. However, the site of the AWTP is poor quality wildlife habitat due to the lack of vegetation.

Sensitive Areas

Most of the South Platte River Facilities would be located in the South Platte River PCA and the diversion dam and outlet structure would also be located in the South Platte River Greenway. The Project would involve both temporary and permanent impacts within these areas. Because much of the habitat is already disturbed and the South Platte River Facilities would occupy only a small part of the PCA and Greenway, construction of these facilities would not adversely affect the viability of the PCA or Greenway.

Conduit O

Conduit O is a new 36-inch diameter pipeline that would extend between the Moffat Collection System delivery point at SH 72 (South Boulder Diversion Canal) and the proposed AWTP along Brighton Boulevard. It is assumed that the conduit would be constructed within existing roadways (curb-to-curb). Crossing the South Platte River and Farmer's Highline and Croke canals would be open cut per Denver Water's standard method (see Section 2.5 of the Moffat Project FEIS). Each crossing would be completed in 20 working days, depending on weather and other conditions.

Construction of Conduit O would occur within the existing road ROWs. Habitats adjacent to or crossed by Conduit O include grassland, urban/developed, riparian and wetland, and open water. Riparian habitats crossed include Farmer's Highline and Croke canals, and the South Platte River. Permanent impacts to 0.08 acre of grassland wildlife habitat would occur from construction of the dechlorination facility at the western end of Conduit O.

Big Game

Big game animals likely to occur along Conduit O are elk, mule deer, and white-tailed deer. Elk may occur in the western portion of the conduit (near the Rocky Flats National Wildlife Refuge) between May and June, during calving season. Elk may cross SH 93 in the vicinity of SH 72, but calving would not likely occur near or at the conduit. Mule deer and white-tailed deer could occur along the major riparian corridors, primarily the South Platte River, crossed by Conduit O. Deer would likely avoid areas during construction.

Small- and Medium-sized Mammals

Small, less mobile mammal species would incur direct impacts from mortality. These species would likely be crushed or buried during earth-moving activities. Medium-sized mammals such as coyotes, foxes, and raccoons would temporarily avoid construction areas during construction. No prairie dog colonies would be impacted by construction of Conduit O.

Raptors

During 2005 surveys, raptor nests were identified at the eastern terminus of Conduit O. If construction begins after the start of the nesting season (generally March 15 to July 31), construction activity may remove trees with active nests or cause abandonment of active nests in the vicinity of construction, resulting in the loss of eggs or young. A nest survey should be conducted prior to construction to determine if active nests are present, and construction should be avoided in the vicinity of active nests until chicks have fledged.

Other Birds

Construction of Conduit O at riparian crossings, including Croke and Farmers Highline canals and the South Platte River would potentially disrupt nesting activity of waterfowl and other birds. If construction begins after the start of the nesting season (generally April 1 to July 31), construction activity may remove trees with active nests or cause nest abandonment, resulting in the loss of eggs or young.

Reptiles and Amphibians

Impacts to reptiles and amphibians would be limited since construction of Conduit O would occur in the existing roads. Conduit construction at riparian crossings has the potential to kill or crush reptiles and amphibians during trenching. More mobile species may avoid earth-moving activities, although smaller, less mobile species may be crushed or buried by construction.

Sensitive Areas

Sensitive areas along the South Platte River would be impacted under Alternative 8a from construction of the South Platte River Facilities and Conduit O where it crosses the South Platte River. The crossing of Conduit O over the South Platte River would be located in both the South Platte River PCA and South Platte River Greenway. A small area of habitat would be temporarily affected during construction. Because of the small area and temporary impacts, construction of the crossing would not adversely affect these areas.

River Segments

Impacts would be similar to those described under the Proposed Action. Changes in flow and resulting changes in wildlife habitats would be the same or nearly the same, and would be negligible to minor along the various stream segments.

5.3.5 Alternative 10a

Gross Reservoir

Impacts to wildlife and wildlife habitat under Alternative 10a would be the same as described under Alternative 8a.

Denver Basin Aquifer Facilities

Construction of the AWTP, which would occupy approximately 4 acres, would not likely disturb wildlife due to the urban/industrial land use in the vicinity of the AWTP site. Well sites would be within recreational parks and would not likely disturb wildlife due to high levels of current human activity.

The aquifer distribution pipelines would consist of approximately 36 miles of 12- to 48-inch pipeline buried curb-to-curb and within urban utility corridors. This pipeline would cross Clear Creek, the South Platte River, Cherry Creek in three locations, and Sand Creek. Two of the Cherry Creek crossings are in highly urban areas, and wildlife impacts are not expected. Cottonwood/ peachleaf willow woodland is present at the southern South Platte River crossing, the Sand Creek crossing, and the easternmost crossing of Cherry Creek. Impacts to wildlife at these crossings would be temporary and consist of disturbance during construction activities, as well as mortality to smaller animals from crushing or burying from earth moving.

Conduit M

The alignment for Conduit M is the same for Conduit O between the Moffat Collection System delivery point and the intersection of 80th Avenue and Pierce Street. Habitats adjacent to and crossed by Conduit M include grassland, urban/developed, riparian and wetland, and open water. Riparian habitats crossed include Farmer's Highline and Croke canals, Little Dry Creek, Clear Creek, and the South Platte River. Less than 0.01 acre of cottonwood/willow riparian woodland habitat would be impacted at Little Dry Creek, while no habitat would be permanently or temporarily impacted by construction of Conduit M.

The impacts to wildlife from the western terminus to 80th Avenue and Pierce Street would be the same as described under Conduit O for Alternative 8a. Impacts to wildlife from construction of Conduit M east of 80th Avenue and Pierce Street are discussed below.

Big Game

Mule deer and white-tailed deer inhabiting the Clear Creek and South Platte River corridors would be disturbed during construction. Disturbance to individual deer would result in avoidance of construction zones for the duration of activity. However, movement patterns would be expected to return to normal following construction.

Small- and Medium-sized Mammals

Impacts to small- and medium-sized mammals from construction of Conduit M would be similar to those described for Conduit O.

Birds

Impacts to birds from construction of Conduit M would be similar to those described for Conduit O.

Reptiles and Amphibians

Impacts to reptiles and amphibians from construction of Conduit M would be similar to those described for Conduit O.

Sensitive Areas

Impacts to sensitive areas would be similar to those as described for Alternative 8a for Conduit O. The crossing of Conduit M over the South Platte River would be located in both the South Platte River PCA and South Platte River Greenway and one of the pump stations would be located in the PCA. A small area of habitat would be temporarily affected during construction. Because much of the habitat is already disturbed and these facilities would occupy only a small part of the PCA and Greenway, construction of these facilities would not adversely effect the viability of the PCA or Greenway.

River Segments

Impacts to river segments would be the same as described under the Proposed Action.

5.3.6 Alternative 13a

Gross Reservoir

Impacts to wildlife would be similar to the Proposed Action, although less habitat would be removed under Alternative 13a for a 60,000 AF enlargement. The enlarged reservoir would result in loss and fragmentation of habitat, as described under the Proposed Action. In riparian areas such as Winiger Gulch and Forsythe Gulch, Alternative 13a would result in slightly less fragmentation because the water level would be lower. Approximately 2,320 feet of South Boulder Creek and 2,045 linear feet of Winiger Gulch would become inundated and impassable for wildlife.

The loss of elk winter habitat represents approximately 1.2% of the habitat in the map unit; 0.25% of this loss would be temporary. Approximately 1.6% of elk severe winter range in the map unit would be lost due to reservoir expansion; including about 0.3% of temporary impacts to severe winter range. Direct losses of habitat would be less than the Proposed Action, and would be less than 1% of the habitat available to the Clear Creek elk herd, a minor impact. About 6.5% of the migration corridor would be lost due to the Proposed Action, of which about 1.3% would be temporary impact. Permanent loss of portions of the migration corridor would likely cause changes

in elk migration patterns, as described for the Proposed Action. Alternative 13a would affect about 515 acres of mule deer summer range, which would have a minor effect on the mule deer herd.

Alternative 13a would affect smaller amounts of USFS wildlife habitats at Gross Reservoir than the Proposed Action but more than Alternatives 1c, 8a, or 10a. The affected habitats include existing old growth, developing old growth, forested corridors, open corridors, effective habitat, and interior forests. As with the Proposed Action, losses of inventoried and developing old growth and reductions in effective habitat may be in conflict with ARNF management goals. Losses of forested and open corridor would occur adjacent to the existing reservoir and would not cause a reduction in connectedness.

Alternative 13a impacts to MIS species at Gross Reservoir would be similar to the Proposed Action. Alternative 13a would have a smaller footprint and would affect a smaller amount of habitat for each of the species than the Proposed Action, but more than Alternatives 1c, 8a, or 10a. In addition to elk and mule deer, described above, Alternative 13a would affect about 177 acres of pygmy nuthatch habitat (existing and potential old growth), about 231 acres of hairy woodpecker habitat (forests), and about 44 acres of mountain bluebird habitat (openings). Impacts to these species would reduce local populations but would be minor on a regional basis. Alternative 13a would also remove about 5.3 acres of warbling vireo habitat, a negligible impact. Golden-crowned kinglet and Wilson's warbler are unlikely to breed in the Gross Reservoir study area, and loss of habitat is expected to have a negligible effect on migrating birds. There would be no impacts to Rocky Mountain bighorn sheep or boreal toad in the Gross Reservoir area.

Under Alternative 13a, direct impact to the Winiger Gulch PCA includes inundation of 61.6 acres (3.2% of total PCA area). The Winiger Ridge ECA would lose 211.8 acres (6.1%) to inundation.

South Platte River Facilities

Impacts from gravel pits would be similar to those described under Alternative 8a. The gravel pit pipeline would extend 5 miles to the northern Challenger Pit and would cross the South Platte River at Bridge Street. Impacts at this crossing would be similar to those described under Alternative 8a for the Conduit O crossing of the South Platte River.

Transfer of agricultural water rights would result in conversion of about 3,900 acres of irrigated land to dryland agriculture, as well as the loss of about 83.87 acres of wetlands and 8 acres of surface water in ditches and ponds. Most of the affected area is likely to have low to moderate value for wildlife. Although these land use changes would affect the numbers and types of animals in the affected area, the wildlife of the affected area would continue to be dominated by species adapted to rural habitats, and most of the species currently present would continue to be present. Species adapted to aquatic habitat and to more mesic environments would likely decrease, such as red-winged blackbird, raccoon, ring-necked pheasant, waterfowl, garter snakes, turtles, and frogs. Migratory birds that feed on waste corn would have reduced foraging habitat. The area of upland grasslands would likely increase and species adapted to this habitat may increase. Prairie dog towns would likely expand. Trees and shrubs growing along irrigation ditches may have reduced growth or may be killed by drought, resulting in a minor loss of habitat for breeding birds. The lower vegetation productivity of nonirrigated land may result in a reduction of prey base for raptors and other carnivores, but increases in prairie dogs would be beneficial.

Conduit O

Impacts from construction of Conduit O would be similar to those described for Alternative 8a.

River Segments

Impacts would be similar to those described under the Proposed Action. Changes in flow and resulting changes in wildlife habitats would be the same or nearly the same and would be negligible to minor along the various stream segments.

6. (SUBPART E) SPECIAL AQUATIC SITES

6.1 SANCTUARIES AND REFUGES (230.40)

No areas considered sanctuaries or refuges would be impacted by the action alternatives.

6.2 WETLANDS

A more thorough discussion of wetland impacts is included in Section 5.8 of the Moffat Project FEIS. Potential effects to wetlands under all alternatives are listed in Table 4.

Table 4
Summary of Direct Impacts to Wetlands

Study Area		Wetland Impact by Alternative (acres)									
		Proposed Action (Alternative 1a)		Alternative 1c		Alternative 8a		Alternative 10a		Alternative 13a	
		P	T	P	T	P	T	P	T	P	T
Gross Reservoir											
Wetland Type	PEM	0.43	--	0.43	--	0.43	--	0.43	--	0.43	--
	PSS	1.03	--	0.74	--	0.86	--	0.86	--	0.93	--
	PEM/PSS	0.49	0.12	0.43	0.12	0.46	0.12	0.45	0.12	0.47	0.12
	Total	**1.95**	**0.12**	**1.60**	**0.12**	**1.75**	**0.12**	**1.75**	**0.12**	**1.83**	**0.12**
Leyden Gulch Reservoir											
Wetland Type	PEM	--	--	4.49	12.50	--	--	--	--	--	--
	PSS	--	--	0.06	--	--	--	--	--	--	--
	PEM/PSS	--	--	--	0.68	--	--	--	--	--	--
	Total	--	--	**4.55**	**13.18**	--	--	--	--	--	--
South Platte River Facilities											
Wetland Type	PEM	--	--	--	--	--	--	--	--	--	--
	PSS	--	--	--	--	--	--	--	--	--	0.02
	PEM/PSS	--	--	--	--	0.02	0.22	--	--	0.04	0.22
	Total	--	--	--	--	**0.02**	**0.22**	--	--	**0.04**	**0.24**
Denver Basin Aquifer Facilities											
Wetland Type	PEM	--	--	--	--	--	--	--	<.01	--	--
	PSS	--	--	--	--	--	--	--	0.03	--	--
	PEM/PSS	--	--	--	--	--	--	--	0.02	--	--
	Total	--	--	--	--	--	--	--	**0.05**	--	--

Table 4 (continued)
Summary of Direct Impacts to Wetlands

Study Area		Wetland Impact by Alternative (acres)									
		Proposed Action (Alternative 1a)		Alternative 1c		Alternative 8a		Alternative 10a		Alternative 13a	
		P	T	P	T	P	T	P	T	P	T
Transfer of Agricultural Water Rights											
Wetland Type	PEM/PSS	--	--	--	--	--	--	--	--	82.0	--
Conduit O											
Wetland Type	PEM	--	--	--	--	--	<0.01	--	--	--	<0.01
	PSS	--	--	--	--	--	--	--	--	--	--
	PEM/PSS	--	--	--	--	--	0.06	--	--	--	0.06
	Total	--	--	--	--	--	**0.06**	--	--	--	**0.06**
Conduit M											
Wetland Type	PEM	--	--	--	--	--	--	--	0.02	--	--
	PSS	--	--	--	--	--	--	--	--	--	--
	PEM/PSS	--	--	--	--	--	--	--	--	--	--
	Total	--	--	--	--	--	--	--	**0.02**	--	--
Total for Alternative		**1.95**	**0.12**	**6.15**	**13.43**	**1.77**	**0.4**	**1.75**	**0.19**	**83.87**	**0.42**

Notes:
Jurisdictional status is based on a preliminary assessment. A formal jurisdictional determination has not been obtained from the Corps.
The calculation of the noted acres assumes disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the expanded reservoir of the Environmental Pool for mitigation (elevation 7,406 feet).
P = permanent PSS = palustrine scrub/shrub
PEM = palustrine emergent T = temporary

6.2.1 No Action Alternative

The No Action Alternative (i.e., both the Depletion of the Strategic Reserve and Combination strategies) would have no direct effects on wetlands. Operational flow changes would create minor impacts to riparian areas in most rivers in the FEIS study area.

Depletion of Strategic Water Reserve Strategy

With this alternative, Denver Water would continue to operate their existing system at Full Use of the Existing System but under a higher demand. In addition, the No Action Alternative would use a combination of depleting the 30,000 AF Strategic Water Reserve and more frequent mandatory restrictions on use during droughts. Stream flows would change compared to Full Use of the Existing System because of operational changes including increased use of Blue River and South Platte River supplies and the Strategic Water Reserve, especially during droughts. Hydrologic impacts would be less than the action alternatives in the Fraser and Williams Fork river basins and greater in the Blue River Basin. Flows in South Boulder Creek above and below Gross Reservoir would be less on average than the action alternatives while flows in the North Fork South Platte River would increase on average due to additional Roberts Tunnel imports from the Blue River Basin.

Modeled changes in the wetland area affected by changes in 2-year flows associated with this alternative are presented in Table 5.8-13. Changes from Full Use of the Existing System would be

higher than the Proposed Action at the sampling site on the Blue River (BR1), but the same or less at all other sampling sites. The largest changes would occur at sampling site BR1, where changes in the area affected under No Action Alternative would be twice as much as changes in the affected area under the Proposed Action. The 2-year flow elevation would decrease by 5.6 inches under the No Action Alternative compared to Full Use of the Existing System, and the width of the inundated area would be reduced by 4.6 feet, a reduction of less than 5% of the channel width at Full Use. Changes at other sampling sites would be less than 2 inches in flow elevation and 1 foot in channel width. Changes would be minor along the Blue River (site BR1), and would be negligible or none at the other sites. Changes in flow are unlikely to adversely affect riparian and wetland habitats along the South Platte River, because flow changes would generally be small on both an annual average and monthly basis, as shown in Table 5.

Table 5
Two-Year Flow Changes for Sampling Sites,
No Action Alternative Compared to Full Use of the Existing System

Sampling Site	Average Channel Width of 2-Year Flow at Full Use (feet)	Impacts of No Action Alternative Compared to Full Use of the Existing System			Proposed Action 2-Year Area of Flow Change (acres/mile)
		2-Year Flow Elevation Change (inches)	2-Year Flow Width of Change (feet)	2-Year Area of Flow Change (acres/mile)	
FR1	28.38	-1.91	-0.95	-0.12	-0.39
FR2	83.88	-0.04	-0.11	-0.01	-0.62
FR3	51.12	+0.10	+0.14	-0.02	-0.30
FR4	20.10	0.00	0.00	0.00	-0.03
WF1	69.97	0.00	0.00	0.00	0.00
WF2	29.97	0.00	-0.00	0.00	-0.02
CR1	139.11	-0.15	-0.08	-0.01	-0.01
BR1	100.88	-5.57	-4.64	-0.56	-0.25
SBC1	46.10	+0.18	+0.07	+0.01	+0.08
SBC3	70.26	+0.77	+0.75	+0.09	-0.57
NF1	53.86	0.00	+0.14	+0.02	+0.02
NF2	64.43	+0.36	+0.09	+0.01	+0.02

Changes in flow elevations and channel widths due to changes in the 5- and 10-year flows under the No Action Alternative are presented in Table 5.8-14, for locations where changes are different than for the Proposed Action. About half of the sampling sites would have changes that are the same as the Proposed Action and are therefore not shown in Table 5.8-14. Changes in 5- and 10-year flows under the No Action Alternative would be less than under the Proposed Action and other action alternatives, and would result in changes in flow elevations of less than 2 inches and changes in channel width of less than 2 feet at all sites. Effects on riparian and wetland vegetation would be negligible, as shown in Table 6.

Table 6
Five- and 10-Year Flow Changes for Sampling Sites,
No Action Alternative Compared to Full Use of the Existing System

Sampling Site	Average Channel Width Flow at Full Use (feet)	Impacts of No Action Alternative Compared to Full Use of the Existing System			Proposed Action Area of Flow Change (acres/mile)
		Flow Elevation Change (inches)	Flow Width of Change (feet)	Area of Flow Change (acres/mile)	
5-Year Flows					
FR1	36.68	-0.56	-0.52	-0.06	-0.33
FR2	102.52	-0.66	-1.92	-0.23	-0.29
FR3	58.49	-0.08	-0.11	-0.01	-0.15
CR1	177.89	-1.34	-1.67	-0.20	-0.24
BR1	108.11	-0.43	-0.23	-0.03	0.00
SBC1	47.08	+0.06	+0.02	+0.001	+0.01
SBC3	73.38	-0.44	-0.44	-0.05	-0.24
10-Year Flows					
FR1	42.13	-1.59	-1.54	-0.19	-0.50
FR2	139.22	-0.03	-0.17	-0.02	-2.02
CR1	186.54	-0.34	-0.24	-0.03	-0.15
BR1	108.89	-1.22	-0.62	-0.08	0.00
SBC1	47.22	0.00	0.00	0.00	+0.01
SBC3	74.97	-0.47	-0.45	-0.05	-0.29

For the Fraser River and Williams Fork tributaries, the percent change in flows from Full Use of the Existing System under No Action would be the same or slightly less than the Proposed Action.

Combination Strategy

No additional impacts on riparian vegetation would result from implementing the Combination Strategy. During a drought, stream flows could decrease in some streams because less water would be released from storage.

6.2.2 Proposed Action

The Proposed Action would result in direct major permanent effects to 1.95 acres of wetlands and temporary effects to 0.12 acre. The permanent impact would require a Section 404 individual permit. All of these direct effects to wetlands would occur at Gross Reservoir. Most of the permanent impacts would occur from inundation of creek and gulch inlets and shoreline wetlands. An equivalent area of shoreline wetland (approximately 0.5 acre) is likely to re-establish along the new shoreline. Larger areas of shoreline wetlands are unlikely to become established because of extreme seasonal fluctuations in reservoir water levels. Temporary impacts would occur along South Boulder Creek from construction of the dam and at Chamberlain Gulch from construction of the spillway.

Indirect impacts would occur from changes in stream flows. The FEIS includes a detailed analysis of the interaction between flow change and inundated area for each drainage potentially affected by the Moffat Project, based on detailed field studies and simulation of flows. Modeled changes in flood elevations and widths that would result from the Proposed Action and other alternatives, compared to Full Use of the Existing System, are shown in Tables 5.8-4, 5.8-5, and 5.8-6. The

results for each river segment are discussed below. The elevation and width changes in this and the other tables in this section represent an average of the results from about 14 transects within each representative reach. The sampling sites represent a small portion of each affected river segment and results will vary by channel geometry and distance from the diversion, but are considered to be generally representative of the river segment in which they are located.

Fraser River

Sampling Site FR1. Four sampling sites were established in the Fraser drainage (Fraser River [FR]1, FR2, FR3, and FR4), which includes streams with some of the highest levels of proposed flow modification. At these locations, the FR1 site near Winter Park would have the highest depletion level. There would be an average flow reduction in May and June of approximately 40% compared to Full Use of the Existing System. In terms of actual flow numbers, the average flow in June would drop from 53 cfs to 30 cfs at the gage. The impact of additional diversions would result in a reduction in stage (stream elevation) for a 2-year flow event at FR1 (136 cfs under Full Use versus 54 cfs under the Proposed Action, of approximately 8 inches).

The width of the 2-year flow would be reduced by about 3 feet, about 11% of the channel width at Full Use. The total area within the zone between the existing and simulated stream profile in the sample site would be approximately 0.04 acre. The amount of area affected would remain very small even when extrapolated over a longer distance (e.g., a 1-mile segment would experience a reduction in inundated area of approximately 0.39 acre). The width of the area of reduced inundation, as measured at the sampling site, would be approximately 1.6 feet on each side of the channel.

Within the narrow zone of reduced inundation, vegetation would respond in a variety of ways. Shallow rooted herbaceous vegetation that requires hydric conditions is the plant group most vulnerable to changes in inundated area (Stromberg et al. 2005). The heartleaf bittercress-tall fringed bluebells-arrowleaf ragwort herbaceous community typically occurs in narrow bands along flowing streams (Carsey et al. 2003) and is an early seral community that is maintained by frequent disturbance from the 2-year flows. Over time, it is likely that herbaceous vegetation within the area affected by the change in 2-year flows would respond to somewhat drier conditions and show a transition to more tolerant species such as bluejoint. Some individual trees and shrub species may be adversely affected over time, but the overall impact on these species would be minor. The reduction in wetted area would be small, ranging from approximately several inches to just over 1.5 feet, a distance that is sufficiently narrow to allow trees and shrubs with large root masses to adapt. Further, these species are less dependent on periodic inundation and at many locations are supported by contact with groundwater, normal precipitation and hillside runoff.

At this sampling site, implementation of the Proposed Action would have minor effects to several other wetland and riparian functions, including maintenance of fish/aquatic habitat, flood attenuation, short- and long-term water storage, and production export/food chain support. Impacts to other functions would be negligible. The amount of shading of the stream is not likely to change. Here and at the other sample sites, changes in functions would be localized along the edge of the river and would not affect wetlands or riparian areas that are more than a short distance away from the river, or that are primarily supported by groundwater or flow from undiverted tributaries.

Sampling Site FR2. The Fraser Canyon Reach (FR2) is located approximately 1 mile downstream of Tabernash and consists of a study reach length of 872 feet. Average flows would be reduced during the spring runoff season (May-July), with average flow in June diminished by 19% from 476 cfs to 388 cfs. The 2-year flow would be reduced from 824 cfs under the Proposed Action to 659 cfs under Full Use of the Existing System.

The stream elevation of the 2-year flow would drop by approximately 3.5 inches. The width of the 2-year flow would be reduced by about 5 feet, about 6% of the channel width at Full Use. Expressed in terms of area, the reduction in inundated area at the sampling site would amount to approximately 0.1 acre, or when extended over a 1-mile distance, the area becomes 0.6 acre. The width of the area of reduced inundation, as measured at the sampling site, would be approximately 2.6 feet on each side of the channel.

The plant community that primarily occurs along the side of the channel is narrow strips of bluejoint reedgrass herbaceous community adjacent to the stream, and the edge of the Geyer willow-mountain willow-bluejoint reedgrass that occupies much of the sampling site. There are several small side channels or overflow channels dominated by beaked sedge herbaceous vegetation. The narrow strips of bluejoint reedgrass herbaceous vegetation along the edge of the channel are likely maintained by disturbance associated with the 2-year flow and are likely to continue to exist along the edge of the narrower channel. The areas currently occupied by these communities are likely to be occupied by other riparian species, especially Geyer's willow and mountain willow. Reduced inundation or localized deepening of the water table may cause the beaked sedge herbaceous vegetation to be replaced by bluejoint reedgrass or other species that can tolerate somewhat drier conditions. The riparian shrub communities that occupy most of the sampling site are generally above the zone that would be affected by the 2-year flow. Where they are within the 2-year flow there may be a shift in the herbaceous vegetation toward more mesic species. The existing shrubs are likely to adapt to somewhat drier conditions, but may gradually change in composition to include more mesic species such as shrubby cinquefoil and conifers. Similar changes could occur from reductions in the height of the water table along the stream banks.

Changes in flow at this sampling site would result in minor changes to wetland and riparian habitat including changes in composition to more mesic species in areas adjacent to the stream. Implementation of the Proposed Action could have minor effects to several wetland and riparian functions, including support of fish and aquatic habitat and populations, flood attenuation, short- and long-term water storage, and production export and food chain support. Impacts to other functions would be negligible. The existing riparian vegetation provides minimal shading of the stream and this would not change.

Sampling Site FR3. This site is located on St. Louis Creek above the Town of Fraser (refer to Figure 3.0-2 in Chapter 3 of the Moffat Project FEIS). This site is also situated at an elevation of approximately 9,000 feet. Average monthly flow reductions at this location would be less than at the mainstem Fraser site, reaching a maximum of 26% in June. Average monthly flows in June would drop from 39 cfs under Full Use to 29 cfs under the Proposed Action. The 2-year flow would be reduced from 188 cfs under Full Use to 154 cfs under the Proposed Action at FR3.

The stream elevation of the 2-year flow would drop by about 2 inches compared to Full Use. The width of the channel would be reduced by about 2.5 feet, about 5% of the bankfull stream width at full use. The reduction in inundated area over the length of the 335-foot segment that was evaluated would be approximately 0.02 acre. If extrapolated over a distance of 1 mile, the Area of Potential Effects increases to approximately 0.3 acre. The width of the area of reduced inundation, as measured at the sampling site, is approximately 1.3 feet on each side of the channel.

The plant communities that mostly occur along the edge of the channel are heartleaf bittercress-tall fringed bluebells-arrowleaf ragwort herbaceous community and thinleaf alder-Drummond's willow shrubland. The herbaceous community is an early seral community that is maintained by frequent disturbance. It is likely to move or expand to stay within the area of the new 2-year flow, as the channel gradually narrows in response to reductions in the 2-year flow. The area currently occupied by this community is likely to be gradually occupied by other riparian species, including

Drummond's willow and thinleaf alder. Thinleaf alder-Drummond's willow shrubland is a common community along relatively fast-moving streams with stable shaded streambanks. Reductions in the 2-year flow and narrowing of the stream may cause this community to gradually shift in position to the new stream edge. The upper edges of this community may gradually change to a subalpine fir-Engelmann spruce/thinleaf alder community as conifers become established.

Changes in flow at this sampling site would result in minor changes to wetland and riparian habitat including changes in composition to more mesic species in relatively small areas adjacent to the stream. At this sampling site, implementation of the Proposed Action would have minor effects to several wetland and riparian functions, including support of fish and aquatic habitat and populations, flood attenuation, and short- and long-term water storage. Impacts to other functions would be negligible. The amount of shading of the stream is not likely to change.

Sampling Site FR4. One other site in the upper Fraser River Basin was evaluated (FR4), a site on Ranch Creek just below the confluence with the North Fork of Ranch Creek. This sample site has a limited amount of riparian vegetation because of its topographic setting; it is a Rosgen Type A stream with steep to vertical cuttbanks and riparian vegetation narrowly confined to the margins of the stream. Average monthly flows in June would drop from 20 cfs to 16 cfs, a 21% reduction. Reductions in flow would occur in May, June, and July and there would be little or no change during the remainder of the year below the diversion. The 2-year flow would be reduced from 77 cfs under Full Use to 68 cfs under the Proposed Action at FR4.

The stream elevation of the 2-year flow would drop by approximately 1 inch, and the width of the channel would be reduced by about 0.27 feet, about 1% of stream width at Full Use. The reduction in inundated area over the length of the 571-foot segment that was evaluated would be less than one hundredth of an acre, or 0.03 acre when extrapolated over a 1-mile distance. Plant communities along the edge of Ranch Creek include heartleaf bittercress-tall fringed bluebells-arrowleaf ragwort herbaceous vegetation, subalpine fir-Engelmann spruce/tall fringed bluebells forest, and subalpine fir-Engelmann spruce/thinleaf alder forest. Because of the small change to the 2-year flow, changes to these plant communities are likely to be confined to the edge of the stream and consist of shifts in vegetation composition. These changes are expected to be negligible.

Fraser River Tributaries. In addition to St. Louis Creek and Ranch Creek where sampling was conducted, there are 31 other tributaries in the Fraser Valley from which water is diverted by Denver Water. Under the Proposed Action, the amount of water diverted would increase from all of these creeks. A number of these streams have minimum bypass requirements, while others that do not have minimum bypasses are already fully diverted at times during the year (Denver Water 2009). The two tributaries that were evaluated at sampling sites FR3 and FR4 both have minimum bypass flows.

The Proposed Action would include two types of changes to hydrology that could affect wetland and riparian habitats: (1) it would reduce the amount of flow during spring runoff at all diversions, and (2) it would extend the season with no surface flow at some of the diversions. Flows and diversions occur primarily during snowmelt in May, June, and July. Flows in tributaries would be reduced by 20 to 60% in June. Changes in the larger streams and those with bypass flows would be generally similar to those described for sampling sites FR3 and FR4. The pattern of seasonally high stream flow during snowmelt would continue, but the amounts would be reduced. The large valley wetlands along the Rosgen B/C streams are probably maintained by a mix of surface and groundwater, and groundwater discharge was evident at some sites that were assessed in 2010 including lower St. Louis Creek, Jim Creek, and Vasquez Creek. Reductions of flows could have localized effects on groundwater, but discharge of groundwater from adjacent uplands would remain unchanged. Impacts to riparian areas along the Rosgen A/Aa streams would be minor because of

the limited occurrence of riparian habitats. Although the high flows associated with snowmelt would be reduced, there would continue to be seasonally high flows during snowmelt. Reductions of the high flows during snowmelt would reduce hydrology during the growing season, and may result in a gradual reduction in the amount of species such as alder and Drummond's willow.

There are 21 streams in the Fraser Valley without bypass requirements that would have little or no flow during the fall and winter under Full Use. The Proposed Action would extend the period without flow at about half of these diversions. At streams that do have bypass requirements, the reductions in June would be less, and there would be no months without flow in the streams. Lengthening of the season without flow would have little or no effects on the riparian habitats along these streams because it would occur during the cooler months when the riparian plants are less active.

Fraser Valley Fens. The primary source of hydrology for fens is regional groundwater, and the Proposed Action would have no or negligible effects to fens.

Williams Fork

Sampling Site WF2. Two sampling sites were established on the upper portion of the Williams Fork River. At the upper site (Williams Fork [WF] 2), impacts would be very similar to those described for Total Environmental Effects in FEIS Section 4.6.8. Flows would be diminished by 21% in June, from 88 cfs to 69 cfs. Decreased flow would occur in almost every month at the gage. The 2-year flow would decrease from 205 cfs under Full Use to 202 cfs under the Proposed Action at WF2.

Compared to Full Use, the stream elevation of the 2-year flow would drop by approximately 0.2 inch and the channel width would be reduced by 0.16 feet, about 0.5% of the channel width for the 2-year flow at Full Use. Expressed as an area, the reduction over the 590-foot study segment would be approximately 0.002 acre, or 0.02 acre when extrapolated over a 1-mile distance, a negligible effect. The reduction in channel width for the 2-year flow would primarily occur in the narrow areas along the stream edge, in heartleaf bittercress-tall fringed bluebells-arrowleaf ragwort herbaceous vegetation and subalpine fir-Engelmann spruce/Drummond's willow forest. It would not affect the bog birch/mesic forb-mesic graminoid community, which is located above the 2-year flow.

Implementation of the Proposed Action would have no effect on the fen that extends to the edge of the Williams Fork River in the southwest portion of the sampling site, because the fen is topographically higher than the river at bankfull. The small reduction in 2-year flow would not change the sources of hydrology for the fen.

Implementation of the Proposed Action would have minor effects to several wetland and riparian functions, including support of fish/aquatic habitat, flood attenuation, and short- and long-term water storage. Impacts to other functions would be negligible.

Sampling Site WF1. At the Williams Fork River near Sugarloaf Campground site, the flow reduction would be approximately 10% in May and June. The stream elevation of the 2-year flow would not change from Full Use, and there would be no effects to riparian or wetland areas. Implementation of the Proposed Action would therefore have no effects to wetland and riparian functions.

Williams Fork Tributaries. The Proposed Action would include increased diversions from four tributaries of the Williams Fork River. As with the Fraser River tributaries, diversions from tributaries of the Williams Fork River include two types of changes to hydrology that could affect wetland and riparian habitats – they would reduce the amount of flow during spring runoff at all

diversions and would extend the season with no surface flow at some of the diversions. Flows and diversions occur primarily during snowmelt in June and July. Flows in tributaries would be reduced 20-30% in June, the month of highest runoff. The pattern of seasonally high stream flow during snowmelt would continue, but the amounts would be reduced. The Proposed Action would also extend the period without flow, primarily in the fall.

The increased diversions on the Williams Fork tributaries would cause flow reductions in June similar to those at sampling sites FR3, FR4, and WF2. Similar to those sites, impacts to riparian areas from reductions in high flows are expected to be negligible to minor. Impacts from extending the period of no flow in the fall would probably have minor effects because it is mostly after the growing season, and current flows are already low during this period.

Colorado River. One sampling site (Colorado River [CR]1) was established to represent conditions on the Colorado River segment which is located between the towns of Parshall and Hot Sulphur Springs. Reductions in flow would mostly occur from May through July and would be about 13% in June, from 637 cfs under Full Use to 555 cfs under the Proposed Action. The 2-year flow at CR1 would be reduced from 618 cfs under Full Use to 610 cfs under the Proposed Action at CR1.

The change in stream elevation associated with a 2-year event at this segment would be very small (0.15 inch drop in stream elevation), and the change in river width would be about 1 inch, less than 0.1% of the channel width at Full Use (139 feet). The reduction in inundated area would be 0.002 acre within the 953-foot study segment and 0.01 acre when extrapolated over a 1-mile distance. These impacts along the Colorado River would be negligible. The change in wetted channel width would primarily affect reed canarygrass herbaceous vegetation, which occurs at and below the bankfull elevation. This is an aggressive non-native species which can grow under both hydric and mesic conditions and is not likely to be adversely affected by small changes in stream flow. The beaked sedge herbaceous vegetation occurs lower on the banks and would not be affected by changes in the 2-year flow.

At this sampling site, implementation of the Proposed Action would have negligible effects to wetland and riparian functions. The amount of shading of the stream is not likely to change.

Blue River

The 1,000 foot long representative sampling site (BR1) is located along the Blue River midway between Dillon Reservoir and Green Mountain Reservoir. Stream flows would be reduced 8% in June, from 561 cfs under Full Use to 516 cfs under the Proposed Action. The 2-year flow would be reduced from 1,511 cfs under Full Use to 1,358 cfs under the Proposed Action.

The reduction in stream elevation associated with changes in the 2-year flow event at this location would be about 2.4 inches. The width of the stream would be reduced by 2.1 feet, about 2% of the channel width at Full Use. Over a distance of 1,000 feet, this translates to a reduction in inundated area of approximately 0.04 acre, or 0.25 acre when projected over a 1-mile distance. The width of the area of reduced inundation would be approximately 1 foot on each side of the channel. The plant community that is located within the zone of reduced inundation is thinleaf alder-mixed willow shrubland, which occurs as a narrow strip on each side of the river, restricted by topography. On the right (north) side of the river the shrubs are bounded by a steep slope that rises about 25 feet to the valley bottom. On the left bank the strip of dense shrub is bordered by a steep slope and a terrace with groundwater wetlands. There is likely to be little observable impact to the alders and willows because of the small amount of change relative to the size of the plants. The narrow strip of land that results from narrowing of the channel may be gradually occupied by alder, willow or herbaceous wetland vegetation. The width of the streamside shrub community is likely to remain

the same or may increase slightly as the channel narrows because hydrology for the streamside shrubs appears to be provided both from the river and from groundwater wetlands on a terrace above the channel on the south side. The impact on riparian vegetation would be minor.

At this sampling site, implementation of the Proposed Action would have negligible effects to wetland and riparian functions. The amount of shading of the stream is not likely to change.

South Boulder Creek

Sampling Site SBC1. South Boulder Creek above Gross Reservoir would be affected by flow increases as well as flow decreases. In the segment above Gross Reservoir (sampling site South Boulder Creek [SBC]1), flows would increase by 17% in June, from 620 cfs under Full Use to 726 cfs under the Proposed Action, with smaller increases in several other months. These flows are within the normal range of variability at that location. For example, the average monthly flow in June is forecasted to be 726 cfs with implementation of the Project, but flows in excess of 1,100 cfs already occur during wet years at the gage. The 2-year flow at SBC1 would increase from 882 cfs under Full Use to 944 cfs under the Proposed Action.

In terms of stage, the elevation of a 2-year event under the Proposed Action would increase by approximately 1.6 inches. The width of the channel would be increased by about 0.6 feet, about 1% of the channel width at Full Use. The area affected over the 559-foot reach would be 0.008 acre, or 0.08 acre when extrapolated over a 1-mile distance. Within the narrow zone influenced by this increase in stage, there may be a gradual increase in species better adapted to wetter conditions, such as beaked sedge, but the overall impact on riparian vegetation would be negligible. It is also possible that there would be a small increase in the area occupied by riparian vegetation or in the density of riparian vegetation due to the increase in inundated area associated with a 2-year event. The increased 2-year flow would primarily affect the Drummond's willow/mesic forb shrubland.

Implementation of the Proposed Action would have negligible effects to wetland and riparian functions.

Sampling Site SBC3. In the segment below Gross Reservoir and above the South Boulder Diversion Canal, flows would decrease primarily during the months of May, June, and July and would greatly increase from November to February. The reduction in outflow in June would be 13%, from 459 cfs under Full Use to 398 cfs under the Proposed Action. The 2-year flow at SBC3 would be reduced from 645 cfs under Full Use to 574 cfs under the Proposed Action.

The flow elevation would decrease by about 2 inches as a result of the change in the 2-year flow event flow elevation. The width of the channel would be reduced by about 4.7 feet, about 7% of the channel width at Full Use. The area affected over the 446-foot reach would be 0.05 acre, or 0.57 acre when extrapolated over a 1-mile distance.

The width of the area of reduced inundation would be approximately 2.35 feet on each side of the channel. The streambanks in this sampling area are dominated by river birch/mesic forb, which are not likely to be affected by a small change in stage. The herbaceous understory generally consists of species, such as bluejoint reedgrass, that are capable of adapting to somewhat drier conditions. This community is likely to gradually colonize the gravel bars on the edge of the reduced channel. Most of the redtop herbaceous vegetation would not be affected. The beaked sedge and bluejoint reedgrass herbaceous vegetation communities along the banks would likely move to maintain their position along the narrower streambank. The impact on riparian vegetation would be minor.

At this sampling site, implementation of the Proposed Action would have negligible effects to wetland and riparian functions. The amount of shading of the stream is not likely to change.

North Fork South Platte River

Sampling Site NF1. Two sampling sites were established along the North Fork South Platte River (North Fork [NF] 1 and NF2), both of which would experience a decrease in flows during the winter months and an increase in flows during the summer months.

Average monthly flows at the North Fork South Platte River above Geneva Creek gage would increase by approximately 10 to 20% during the period May through August. The average monthly flow in June would increase from 356 cfs under Full Use to 404 cfs under the Proposed Action. The 2-year flow at NF1 would increase from 628 cfs under Full Use to 636 cfs under the Proposed Action. The increased summer flows would fall within the normal range of variability from year to year that already occurs. The average monthly flow decrease at this location during the period November-March would range from 25 to 30% (Table H-3.41). In the absence of an impact on groundwater levels, which is not expected due to an overall increase in flows, decreased flows in winter should not have any impact on riparian vegetation during its dormant period.

The increase in flow elevation from changes in the 2-year event would be less than an inch. The width of the channel would be increased by about 0.14 feet (about 2 inches), about 0.2 to 0.3% of the channel width at Full Use. The area affected over the study reach would be 0.001 acre, and only 0.02 acre when extrapolated over a 1-mile distance. Impacts would occur in the blue spruce/river birch community at NF1. These impacts on riparian vegetation would be negligible.

Flow changes along the North Fork South Platte River at NF1 would have negligible effects on wetland and riparian functions under the Proposed Action.

Sampling Site NF2. Like NF1, NF2 (North Fork South Platte River near Pine), would experience a decrease in flows during the winter months and an increase in flows during the summer months (Table H-3.41). The 2-year flow at NF2 would increase from 652 cfs under Full Use to 683 cfs under the Proposed Action.

The increased flow elevation as a result of changes in the 2-year event would be 0.7 inch at sampling site NF2. The channel width associated with the 2-year flow would be increased by about 0.16 feet, about 2 inches. The area affected would be less than 0.001 acre within the sampling site, and about 0.02 acre extrapolated over a 1-mile distance. The changes would have negligible impacts to the strapleaf and sandbar willow communities at NF2.

Flow changes along the North Fork South Platte River at NF2 would have negligible effects on wetland and riparian functions.

South Platte River

No sampling sites were located along the South Platte River between Antero Reservoir and the Henderson gage because average annual and monthly flow changes would be less than 10% in almost all months of the 45-year study period. Changes in flow during the growing season would be minimal in the upper South Platte River (Antero Reservoir to Cheesman Reservoir outflow) and at the Denver and Henderson gages. Changes at the Waterton gage would be minor – reductions of 2 to 5% in an average year. In dry years, there would be an increase in flow at the beginning of the growing season (April-May) and almost no changes from June to September. These flow changes are likely to have a minimal impact on stream elevation and inundated area during a 2-year event, and no measureable impacts on riparian vegetation would occur.

6.2.3 Alternative 1c

Alternative 1c would result in direct permanent effects to about 6.15 acres of wetlands, of which about 1.60 acres of direct wetland losses would occur at Gross Reservoir and about 4.55 acres would occur at the Leyden Gulch Reservoir site. Temporary effects to wetlands would occur on 13.43 acres, primarily at Leyden Gulch Reservoir. The types of permanent impacts at Gross Reservoir would be similar to those described for the Proposed Action but smaller in area. Permanent impacts at Leyden Gulch would occur from both dam construction and from inundation, and would occur mostly along Leyden Gulch and hillside seeps. Wetlands are likely to establish along the shoreline of the new reservoir where the topography slopes gently and along Leyden Gulch. Most of the temporary area impacts would occur along a tributary of Leyden Gulch from construction of an access road, emergency outlet, and pipeline tunnel. The impact acreage for this wetland was estimated from aerial photographs because the site could not be accessed directly. Flow changes in river segments affected by the Project would be essentially the same as described for the Proposed Action, and the resulting impacts on wetland and riparian vegetation would the same.

6.2.4 Alternative 8a

Alternative 8a would result in direct permanent effects to about 1.77 acres of wetlands. Most of these impacts would occur at Gross Reservoir (1.75 acres), and a small area of direct impacts would occur at the South Platte River Facilities. Temporary impacts would occur on 0.4 acre of wetlands. Permanent impacts at Gross Reservoir would be similar to those described for the Proposed Action but smaller in area. Temporary impacts would occur mostly at the South Platte River Facilities from construction of the diversion structure. Flow changes in river segments affected by the Project would be essentially the same as described for the Proposed Action, and the resulting impacts on wetland and riparian vegetation would the same.

6.2.5 Alternative 10a

Alternative 10a would result in permanent direct effects to about 1.75 acres of wetlands, all of which would occur at Gross Reservoir. Temporary impacts would occur on 0.19 acre of wetlands. Permanent impacts at Gross Reservoir would be similar to those described for the Proposed Action but smaller in area. Construction of the Denver Basin aquifer pipeline would have temporary effects to a small area of wetlands at stream crossings. Flow changes in river segments affected by the Project would be essentially the same as described for the Proposed Action, and the resulting impacts on wetland and riparian vegetation would the same.

6.2.6 Alternative 13a

Alternative 13a would result in direct permanent effects to about 83.87 acres of wetlands. Most of these impacts (about 82 acres) would occur as a result of the loss of irrigation on lands from which agricultural water is transferred. Cessation of irrigation would dry up wetlands, ditches and ponds that are supported by irrigation. Impacts to wetlands also would occur at Gross Reservoir. Temporary impacts would occur to 0.42 acre of wetlands, with the largest area of impacts associated with construction of the diversion structure. Flow changes in river segments affected by the Project would be essentially the same as described for the Proposed Action, and the resulting impacts on wetland and riparian vegetation would the same.

6.3 MUDFLATS

No areas considered to be mudflats would be affected by the Moffat Project alternatives.

6.4 VEGETATED SHALLOWS

No areas considered to be vegetated shallows would be affected by the Moffat Project alternatives.

6.5 CORAL REEFS (230.44)

Not Applicable.

6.6 RIFFLE AND POOL COMPLEXES

The Moffat Project FEIS discusses the effects that the Moffat Project could have on fish and other aquatic species, and on stream morphology. Inundation of riffle/pool complexes would be limited to the increased footprint of Gross Reservoir on the incoming streams (see Sections 3.3, 4.6.3, and 5.3 of the FEIS).

7. (SUBPART F) HUMAN USE CHARACTERISTICS

7.1 MUNICIPAL AND PRIVATE WATER SUPPLIES

Section 4.1 of the Moffat Project FEIS discusses potential impacts to municipal and private water supplies. As discussed in the Section 4.3.2 of this document, no significant effects to the water quality of municipal and private water supplies are expected as a result of the Moffat Project.

7.2 RECREATIONAL AND COMMERCIAL FISHERIES

Section 5.15 of the Moffat Project FEIS discusses potential effects of the Moffat Project on recreational fishing and other forms of recreation. There are no commercial fisheries in the Project area.

7.2.1 No Action Alternative

Under the No Action Alternative, Denver Water would continue to operate their existing system. Full use of Denver Water's existing system supply is projected to occur by 2022. At that time, the amount of available water supply would equal the customer demand on the system. The No Action Alternative would have to rely on some combination of utilizing the Strategic Water Reserve and imposing mandatory restrictions to meet additional demands during drought sequences.

Since there are no ground disturbing activities associated with the No Action Alternative, there would be no direct impacts to recreation. Operational changes, however, would impact recreational activities. On average, reductions in contents in Antero, Eleven Mile Canyon, Cheesman, Dillon, and Gross reservoirs under the No Action Alternative would be greater than reductions under the action alternatives. Lowered water levels would limit shoreline recreational activities, such as fishing, and may render boat ramps inoperable. Impacts to recreation under the No Action Alternative would be similar to those described under the Proposed Action. Overall, the Project would have a long-term adverse impacts on boating on the Fraser River, but no affect on fishing. No impacts are expected to occur to the quality of the fishing experience along the Williams Fork River as a result of the No Action Alternative. Overall, the Project would have little or no impact on boating or fishing in the Colorado River. Boating would be minimally impacted and no impacts

are expected to occur to the quality of the fishing experience along the Blue River as a result of the No Action Alternative. Minor impacts to boating use would occur on South Boulder Creek as well as minor adverse impacts to the quality of fishing along portions of upper South Boulder Creek from the Moffat Tunnel to Gross Reservoir. There may be a minor beneficial effect to the fishing experience on lower South Boulder Creek below Gross Reservoir as a result of higher density fish populations due to reduced flows during runoff. The shift of and increases in flow would create overall neutral to positive impacts on boating use and fishing along the North Fork South Platte River under the No Action Alternative. The impact on boating resulting from flow changes in the South Platte River would be minor and there may be a minor beneficial effect to the fishing experience on the South Platte River as a result of slightly reduced flows.

Depletion of Strategic Water Reserve Strategy

The contents of Williams Fork Reservoir and Wolford Mountain Reservoir would be relatively unaffected by the increased demand in the No Action Alternative. There would be very few and relatively small differences in operations in most months. Without additional storage, Denver Water would rely more heavily on their South Platte River supplies and Strategic Water Reserve to meet a higher demand, particularly during droughts. Thus, reductions in reservoir contents in Antero, Eleven Mile Canyon, and Cheesman reservoirs under the No Action Alternative would be greater than reductions associated with all other alternatives, for all months on average. These reductions may have a moderate impact on recreation at each facility due to lower water levels, which would limit shoreline recreation activities, such as fishing and may render boat ramps inoperable. The lower water levels would also have a moderate negative impact on the recreational experience for other activities, such as hiking, camping, and day use due to the potential unsightly nature of reduced water levels during peak use periods.

Reductions in Dillon Reservoir contents under No Action Alternative would almost always be greater than the reductions associated with all other alternatives, for all months and for average, dry, and wet conditions. This is because without additional storage on-line, Denver Water would rely heavily on their Blue River supplies and Strategic Water Reserve to meet a higher demand, particularly during droughts. During droughts, Dillon Reservoir would be used more heavily than Full Use of the Existing System and the action alternatives, and would be drained to the minimum active content level. This would have a moderate adverse impact on recreation by limiting shoreline recreation activities, such as fishing, and may render boat ramps inoperable. Boating and associated organized boating events are highly popular activities at Dillon Reservoir. Water levels below 8,971 feet render the boat ramp at Dillon Reservoir inoperable and water levels below 9,009 feet render the boat ramp at Frisco inoperable (Denver Water 2008). The lower water levels would also have a moderate adverse impact on the recreational experience for other activities, such as hiking, camping, and day use due to the potential unsightly nature of reduced water levels during peak use periods.

The No Action Alternative is the only alternative in which Gross Reservoir would have lower contents than the Full Use of the Existing System scenario because Gross Reservoir is enlarged in all other scenarios and has significantly greater capacity. Gross Reservoir average end-of-month contents would be lower in some months. Gross Reservoir would be drained to the minimum pool more frequently under the No Action Alternative than under Full Use of the Existing System and the action alternatives. The maximum monthly average reservoir elevation change would be a decrease of 5 feet in an average year, a decrease of 1 foot in a dry year, and a decrease of 14 feet in a wet year. Decreases of this magnitude would have a moderate adverse impact on recreation by limiting shoreline recreation activities, such as fishing, which are particularly popular at Gross Reservoir. Car top boating would likely also be impacted as it would make access to the waterline

more difficult. The lower water levels would also have a moderate adverse impact on the recreational experience for other activities, such as hiking, camping, and day use due to the potential unsightly nature of reduced water levels during peak use periods.

There would generally be only minor changes in stream depletions as compared to Full Use of the Existing System and the Proposed Action. Therefore, impacts on recreational use associated with the No Action Alternative are similar to those described below for the Proposed Action.

Combination Strategy

As related to recreation at municipal parks, pools, golf courses, and other areas where water is required, Denver Water has described emergency water use restrictions that may be instituted as part of its drought response that would likely be part of the combination strategy. During a Stage 1 drought, only voluntary measures are suggested by water users. During a Stage 2 drought, government agencies are restricted to watering only two days per week during the summer use period, and watering is prohibited altogether during fall and winter. The watering of turf areas heavily used by the community, such as athletic and playing fields, and tees and greens at golf courses, as well as government-owned public parks, is not prohibited, but must be conducted without waste of water. The operation of outdoor waterfall and fountains and misting devices is prohibited. This would likely result in fewer visitors to parks and recreation areas with fountains due to the reduced visual appeal and overall park experience. There would also likely be fewer visitors to parks that operate "spray parks" as these would non-operational due to the restrictions.

Response to Stage 3 drought conditions are somewhat more stringent. The watering of turf areas heavily used by the community such as athletic and playing fields is not prohibited, but would be limited to Tuesdays and Fridays and irrigation of such fields would be accomplished without waste of water. The operation of existing outdoor fountains or waterfalls that spray water into the air is also prohibited and no new outdoor fountains or waterfalls may be put into operation during a Stage 3 drought response. Additionally the operation of outdoor misting devices is prohibited. While the filling of single-family residential pools is prohibited, the operation of other pools, such as pools at municipal water parks, would be permitted. Response to a Stage 3 drought would also likely have a moderate adverse impact to recreation resulting in fewer visitors to parks and recreation areas. With the reduced watering schedule, it is likely that the quality of heavily used public turf areas will decline over time and result in a reduced visual appeal. Additionally, this response would likely result in fewer visitors to parks and recreation areas with fountains due to the reduced visual appeal and overall park experience. There would also likely be fewer visitors to parks that operate "spray parks" as these would non-operational due to the restrictions.

Imposing restrictions would allow Denver Water to decrease bypass flows on the West Slope, which would increase the amount physically available for Denver Water to divert. If Denver Water diverts additional water due to decreased bypass flows, then stream flows would decrease on the West Slope. In addition, stream flow could slightly decrease in dry years if greater restrictions were imposed because less water would be released from storage.

Imposing restrictions would generally have the impact of preserving more of the Strategic Water Reserve; therefore, storage contents in Denver Water's reservoirs would likely be higher during a drought. Whether storage contents are higher depends on several factors. The amount and location of water reserved in storage would vary depending on the severity and duration of restrictions imposed, on storage conditions in Denver Water's North and South systems, and on hydrologic conditions. Since storage contents could be higher with restrictions, after a drought Denver Water's diversions into storage could be less and stream flows could increase for a short duration after Denver Water's reservoirs refill. However, this would not occur if a reservoir is drained even with

restrictions in place. Conversely, with greater restrictions, during a drought stream flows would be less in some streams as Denver Water would decrease its releases from storage and decrease bypass flows. In summary, if mandatory restrictions were imposed in combination with depleting the Strategic Water Reserve, the following hydrologic impacts are likely to occur:

- Steam flows would decrease if bypass flows are decreased. For example, Denver Water would divert additional water from the Fraser River in dry years if bypass flows are reduced. This applies to several locations in the Fraser River Basin, the Blue River below Dillon Reservoir, and along the South Platte River below Eleven Mile Canyon Reservoir and Cheesman Reservoir, and at the Old Last Chance Ditch Diversion.
- Stream flows would increase along South Boulder Creek above Gross Reservoir if bypass flows in the Fraser River Basin are decreased since more water would be diverted through Moffat Tunnel.
- Stream flows could increase below Williams Fork Reservoir if additional releases are required to replace out-of-priority diversions at Dillon Reservoir or through Moffat Tunnel if bypass flows are reduced.
- Following a drought, stream flows could be higher for a short duration if Denver Water refills its reservoirs sooner. However, this would not occur if a reservoir is drained even with restrictions in place.
- Reservoir contents would be higher during a drought and when the reservoirs refill if the reservoir is not drained.

Since storage contents could be higher with restrictions in place, Denver Water's diversions into storage could be less after a drought and stream flows could increase for a short duration after Denver Water's reservoirs refill. However, this would not occur if a reservoir is drained even with restrictions in place. Conversely, with greater restrictions, during a drought stream flows would be less in some streams as Denver Water would decrease its releases from storage and decrease bypass flows. However, it should be noted that Denver Water does have the ability to reduce bypass flows during water restrictions. Depending on the level, an increase in stream flow could have either a positive or negative impact on recreation. Increases in stream flow too great may result in a degradation of the fishing experience as high water levels may make it more difficult to catch fish on certain river segments. However, an increase in stream flow may have a positive impact on the boating experience on certain river segments as higher water flows may extend the use season. Conversely, water flows that are too high might make a river unrunable or diminish the experience by covering "play holes."

There would generally be only minor changes in stream depletions in the Project area when comparing Full Use of the Existing System and the Proposed Action. Therefore, impacts on boating and other water-based recreational uses associated with the No Action Alternative are similar to those described below for the Proposed Action.

7.2.2 Proposed Action

Gross Reservoir

The Proposed Action would have direct and indirect impacts on both current and future recreation opportunities at Gross Reservoir. There are nine designated recreation sites at Gross Reservoir. Three of these sites serve as the primary recreation areas and access points for on-water use, such as car top boating, and include the following:

- Dam and Haul Road/Osprey Recreation Area – Site access in these areas would be directly impacted by dam construction activities. Denver Water would either restrict access or completely close the area during construction. This would be a temporary major impact.
- Peninsula Recreation Area – The Peninsula Recreation Area would not be disturbed as a result of construction activities. Denver Water anticipates keeping this area open until the final phases of construction when the area would be relocated. This would be a temporary major impact.

Post-construction, seven of the nine of the recreation areas would be inundated under the Proposed Action, and would result in a moderate temporary impact to recreation. These facilities include:

- Dam Recreation Area
- Haul Road Recreation Area
- Peninsula Recreation Area/Trails below North Shore picnic areas
- Rocky Point
- South Boulder Creek Inlet
- Winiger Gulch Inlet
- Winiger Ridge Recreation Area

All inundated facilities would be relocated to sites above the proposed high water line to allow for continuation of their current use. Therefore, all impacts would be temporary and would last for the length of construction, which is estimated to be four years. Vehicle access to Gross Reservoir would remain open via the north and south access points during the construction period.

After completion, the enlarged reservoir surface and extended shoreline would create additional recreational opportunities. This would be a minor beneficial impact. At the anticipated normal water elevation of 7,406 feet, an enlarged Gross Reservoir is anticipated to have a surface area of approximately 842 acres. This represents approximately 424 additional acres, approximately double the existing surface area of the reservoir. Enlarging the surface area of the reservoir would provide substantial additional space on which people can recreate via car top boating. Additionally, at the anticipated normal water elevation of 7,406 feet with the Environmental Pool for mitigation, the enlarged reservoir is anticipated to have approximately 14 miles of shoreline, representing approximately 2.8 miles more of shoreline than exists currently. The presence of additional shoreline may provide additional dispersed shoreline recreation opportunities such as additional fishing access and would be a beneficial minor long term impact.

As described in Chapter 2 of the FEIS, operations of Gross Reservoir would change with implementation of the Proposed Action. Overall, these operational modifications, including increased storage levels, are not expected to notably change the seasonal pattern of filling and drawdown that already occurs. Therefore, operations are not anticipated to have an impact on recreational use at Gross Reservoir.

River Segments

Recreation on numerous river segments in the Project area would be affected by additional diversions or increases in flow. Several of these drainages provide a variety of recreational opportunities at the regional and local scale. These recreational opportunities include water dependent activities, such as boating and fishing, as well as other activities that are not dependent on water flows, such as mountain biking, hiking, and nature viewing.

Fraser River

Overall, the Project would have a major long-term adverse impact on boating on the Fraser River. These impacts would include a reduction in the average number of days when boating could occur within the optimum flow range in the Fraser Canyon as well as the length of the boating season. There would also be a reduction in the highest flows, resulting in fewer days on average with flows in excess of 700 cfs. However, these higher flow levels would continue in wet years. Given the low use levels for boating in this segment, coupled with a loss of approximately 3.5 days per year to boat within optimum flow levels, represents a loss of approximately 17% of available use days. As such, this would be considered a moderate to major, long-term impact. The Proposed Action would have no impact on boating in dry years.

Flow reductions would not necessarily adversely affect the quality of the fishing experience. Flow reductions during periods of high flows are not likely to adversely affect the quality of the fishing experience. In some cases, flow reductions during periods of high flow may actually provide a minor beneficial effect to the quality of fishing. Reduced flows can expose areas along the river that are typically inundated under higher flows, and would consequently make them accessible to anglers. Additionally, fish tend to lose energy while fighting higher energy flows; therefore, a reduced flow may make them more active. The Proposed Action would have no impact on fishing in dry years. Overall, the Project would have a negligible to minor effect on fishing in the Fraser River.

The Proposed Action would have a minor adverse impact on fish communities in North Fork Ranch Creek. This would have an indirect minor impact to recreation. There may be an associated minor adverse impact on the quality of the recreation fishing experience in this stream.

Snowmaking at local ski resorts occurs primarily from October through December. The PACSM results indicate that there would be very minor depletions (1-2%) occurring during these months under the Proposed Action beyond the Full Use of the Existing System. Therefore, the Proposed Action would not affect snowmaking activities.

Williams Fork River

No impacts are expected to occur to the quality of the fishing experience along the Williams Fork River.

Colorado River

The Colorado River downstream of Kremmling through Gore Canyon is a heavily used recreational area for a variety of boating uses. Under Full Use conditions in normal years, the Colorado River below Kremmling reaches optimum flows for boating during much of the peak season from May through September, and can far exceed optimum levels in wet years. When Denver Water makes Full Use of the Existing System, flows in the Colorado River would be diminished. Under the Proposed Action, average monthly flows would drop during the summer season by 1% in May and August, to 6% in June and 5% in July. Over the period of record, the number of days when flows fall within the desirable range of 800 to 1,250 cfs would decrease only slightly, dropping from 3,948 to 3,937 days, a change of less than 1 day per year on average.

The Proposed Action would have a negligible effect on rafting and minor beneficial effect on kayaking on the Colorado River. The Project would have no impact on boating in dry years. Overall, the Moffat Project would have none to negligible impacts on boating use on the Colorado River in wet and average years. No impacts to fishing on the Colorado River are anticipated.

Blue River

Two river segments were considered in the analysis for the FEIS, including the segment between Dillon and Green Mountain reservoirs and the segment downstream of Green Mountain Reservoir. The Proposed Action would have both positive and adverse impacts to recreational boating. The number of days when flows are within the optimum range decreases with implementation of the Proposed Action in some years and increases in others, though the degree of change is not notable in most years. The greatest change occurs in 1975 when the number of days with optimum flows drops by 8 days for kayaking and by 7 days for rafting. Over the entire 45-year modeling period, the number of days that fall within the optimum range would fall from 459 to 419 days for kayaking, which on average would be less than 1 day per year. For rafting, a similar degree of change would occur, with a reduction of 52 days over the period of record, or just over 1 day on average. This degree of change would result in minor adverse impacts on recreational boating.

No impacts are expected to occur to the quality of the fishing experience on the Blue River as a result of the Proposed Action.

South Boulder Creek

The upper South Boulder Creek segment (Pinecliffe to Gross Reservoir) would be affected by the Proposed Action through increased flows, primarily during the summer months, with the greatest change occurring in June when average monthly flows would increase by 16% over flows associated with Full Use of the Existing System. Although the number of days with very high flows would increase during June, possibly curtailing use on some days by all but the most expert of boaters, the overall impact would be to shift use to periods later in the season. Increased flows in July and later in the summer would extend the boating season on this segment and would therefore not result in a loss of boating opportunities. The overall impact on boating resulting from increased flows would be minor to moderate and beneficial. However, due to the expansion of Gross Reservoir, approximately 0.47 mile of South Boulder Creek upstream of Gross Reservoir would be inundated. This stretch of South Boulder Creek is the lower end of a popular recreational whitewater kayaking run known as the RIMBY (Right In My Backyard) rapid. This section is renowned on the Front Range as one of the few challenging runs for expert boaters, and is especially attractive due to its proximity to the Front Range. Inundation of this stretch of South Boulder Creek would constitute a major, long-term impact on whitewater boating.

It is expected that there would be minor adverse impacts to the quality of fishing along the upper South Boulder Creek segment from a reduction in fish density.

The lower South Boulder Creek segment (Gross Reservoir through Eldorado Canyon), is an expert kayak run that would be influenced by the Proposed Action. At the South Boulder Creek near Eldorado Springs gage, average flows would be slightly reduced during the boating season as a result of the Proposed Action. Monthly average flows would drop by 5% in May and 4% in June as compared to Full Use of the Existing System, resulting in flows rates of 148 cfs and 266 cfs, respectively. One source indicates that the optimum flow range for this segment is 150 to 300 cfs (Southwest Paddler 2007). The impact on boating use would be negligible. There would be negligible adverse impacts to kayaking because of slight reductions in average stream flows. There may be minor beneficial effects to the fishing experience on the lower South Boulder Creek below Gross Reservoir as a result of higher density fish populations due to reduced flows during runoff, particularly during peak runoff in June.

North Fork South Platte River

This river segment includes two reaches that receive boating use: one extending from Bailey to Pine and the second reach extending from Buffalo Creek to the confluence with the mainstem South Platte River.

The 10.5-mile Bailey to Pine reach is a combination of Class IV and V rapids. With implementation of the Proposed Action, this reach would see a major increase in flows during the months of May through August, reaching the highest monthly average flow of 490 cfs in June. These increases would have a moderate to major beneficial impact on boating use, prolonging optimum boating flows throughout the summer. In May, the flows will increase by 20%, from 275 to 330 cfs from Full Use of the Existing System to implementation of the Proposed Action.

The Buffalo Creek to mainstem South Platte River reach is a combination of Class III and IV whitewater. The minimum recommended flow level for boating is approximately 400 cfs (American Whitewater 2006). These flows generally occur only during the months of May and June. On average, the Proposed Action (2032) would increase flows in this segment, increasing monthly averages from 442 cfs under Full Use of the Existing System in June to 490 cfs. The flow changes would have a moderate to major beneficial impact on boating use on this segment.

At the North Fork South Platte River below Geneva Creek gage, the Proposed Action would increase flows during the summer months with the greatest increase occurring in May when the average monthly flow would increase by 29% as compared to the Full Use of the Existing System. This increase may shift the timing of use somewhat during the summer season, but overall would have moderate to major beneficial impacts on boating use.

The increases in flow would not have a major impact on the quality of fishing along the North Fork South Platte River. Flow increases may make it slightly more difficult to fish during periods of high flow, particularly in May, but the overall impact would be minor, resulting in a shift in the period of use to later in the season.

South Platte River

Some kayaking occurs on the South Platte River downstream of the confluence with the North Fork South Platte River to Strontia Springs Reservoir. During the period of highest flows (May and June), average monthly flows would be reduced by 2% and 5%, respectively. On average, flows would decrease by 3% between the months of May and September. This would be a minor degree of change and a minor adverse effect for boaters who enjoy higher flow levels. American Whitewater (2006) indicates that 150 cfs is the minimum flow level for kayaks in the South Platte River above Strontia Springs Reservoir, a flow level that under Full Use of the Existing System extends from May through August. While there would be a slight (4%) decrease in flow in August under the Proposed Action (2032), the impact to the length of the boating season would be negligible and vary from year to year.

There may be a minor beneficial effect to the fishing experience on the South Platte River as a result of slightly reduced flows. Flow reductions during periods of high flow may actually provide a minor beneficial effect to the quality of fishing.

7.2.3 Alternative 1c

Gross Reservoir

The impacts to Gross Reservoir under Alternative 1c would be similar to those described under the Proposed Action. A smaller surface area than the Proposed Action would provide less additional

on-water recreation opportunity; however, it would still be more than what is currently being provided. This alternative would also provide a shoreline of approximately 12.9 miles, approximately 0.6 mile less than under the Proposed Action.

Leyden Gulch Reservoir Site

The construction of a new reservoir at Leyden Gulch would have little impact on existing recreation because the Project site is currently undeveloped rangeland with no developed recreation opportunities or public access. As discussed in Chapter 2, the development of recreation facilities at Leyden Gulch Reservoir is not an aspect of this alternative. Denver Water has indicated that no recreation opportunities would be provided at Leyden Gulch Reservoir and public access to the site would be prohibited. Therefore, there would be no change in the current recreational character at the Leyden Gulch Reservoir site.

There would be a temporary impact to road bicyclists utilizing SH 93 due to its realignment and the reservoir construction. Although SH 93 would remain in service there would be a noticeable increase in heavy truck traffic along the roadway while the road is being realigned as well as throughout the construction of the reservoir. The presence of additional heavy truck traffic along this roadway would present additional safety hazards as well as potentially diminishing the overall recreation experience for road cyclists.

The Jefferson County Open Space Master Plan has identified portions of the Leyden Gulch Site as a "potential open space preservation area" as part of Coal Creek Canyon Park (Jefferson County 2003). The proposed reservoir at Leyden Gulch would potentially conflict with the Master Plan vision for this area. Two Trails 2000 segments are also planned through the site to enhance trail connectivity to Coal Creek Canyon and other open space properties. Construction of the Leyden Gulch Reservoir would have a minor impact on the future alignment of these trails.

River Segments

Impacts to all river segments under Alternative 1c would be similar to those described in the Proposed Action.

7.2.4 Alternative 8a

Gross Reservoir

The impacts to recreation under Alternative 8a would be essentially the same as described for the Proposed Action. The slightly smaller surface size and lower dam height of Gross Reservoir with Alternative 8a would not substantially change the recreational environment of the Project site. A smaller surface area than the Proposed Action would provide less additional on-water recreation opportunity; however, it would still be more than what is currently being provided. This alternative would also provide a shoreline of approximately 13.2 miles, approximately 0.2 mile less than under the Proposed Action.

South Platte River Facilities

For purposes of the Moffat Project FEIS, the Worthing, North Tower, and South Tower pits are identified as representative gravel pits that could be converted into storage pit facilities. Chapter 2 of the Moffat Project FEIS indicates that the final combination of gravel pit lakes would be determined during the design phase. Of these pits, active recreation is currently associated only with the Worthing Pit. The Worthing Pit is used for water skiing, and several trailers are used for seasonal residences on the north side of the lake. There would be no public access or recreational

use permitted if these pits were converted to storage use with Alternative 8a. As such, there would be a major long-term impact on the existing recreation opportunities at the Worthing Pit; water skiing and the existing trailers used as seasonal residences would no longer be permitted. A portion of the proposed South Platte Heritage Project Trail Corridor would traverse the center of the gravel pit disturbance area, along the river. Additionally, a ROW trail and trailhead are proposed along 120th Avenue at the northern edge of the South Platte River Facilities study area (Adams County 1999a, 1999b, 2012). Construction and storage preparation at these gravel pits may conflict with the proposed alignments of these trail corridors.

The gravel pit pipeline, diversion structure, an AWTP, dechlorination facility, and Conduit O would not have direct impacts to recreation, except for some temporary impacts to cycling and kayaking during construction.

River Segments

Impacts to recreation on river segments under Alternative 8a would be similar to those described under the Proposed Action.

7.2.5 Alternative 10a

Gross Reservoir

The impacts to recreation under Alternative 10a would be the same as those described for Alternative 8a.

Denver Basin Aquifer Facilities

The specific locations of the well sites have not been identified; however, the wells would primarily be located within existing City and County of Denver Parks and golf courses. Construction of well sites in any developed park would permanently remove approximately 0.5 acre per site from use for recreation, and would temporarily remove 0.9 acre per site for use during construction. Actual siting of the facilities would occur during preconstruction design and planning, and would include coordination with park or facility managers. Well locations that interfere with park uses or create other conflicts would be avoided. Conduit M would cross proposed and existing bike lanes at multiple locations. The pipeline would not have direct permanent effects on recreation, but would temporarily affect recreation at and near several parks in Arvada and Westminster during construction.

River Segments

Impacts to recreation on river segments under Alternative 10a would be similar to those described under the Proposed Action.

7.2.6 Alternative 13a

Gross Reservoir

The impacts to recreation under Alternative 13a would be essentially the same as described for the Proposed Action. The slightly smaller surface size and lower dam height of Gross Reservoir with Alternative 13a would not substantially change the recreational environment of the Project site. A smaller surface area than the Proposed Action would provide less additional on-water recreation opportunity; however, it would still be more than what is currently being provided. This alternative

would also provide a shoreline of approximately 13.3 miles, approximately 0.1 mile less than under the Proposed Action.

South Platte River Facilities

The impacts to recreation from the South Platte River Facilities including the gravel pit pipeline, diversion structure, AWTP, dechlorination facility, and Conduit O would be similar to those described under Alternative 8a.

River Segments

Impacts to recreation on river segments under Alternative 13a would be similar to those described under the Proposed Action.

7.3 WATER-RELATED RECREATION (230.52)

Water-related recreation is discussed in Section 7.2 in this document.

7.4 VISUAL RESOURCES

Section 5.17 of the Moffat Project FEIS discusses effects to aesthetics/visual resources.

7.4.1 No Action Alternative

As there would be no ground-disturbing activities, there would be no direct impacts to visual resources as a result of the No Action Alternative (i.e., both the Depletion of the Strategic Water Reserve and Combination strategies). However, minor indirect impacts to visual resources would occur at Gross Reservoir as a result of more frequent and prolonged drawdowns. The area between the normal water elevation and the minimum drawdown level would remain barren of vegetation and would create unattractive visual contrasts for observers, particularly recreationists. Additionally, moderate to major adverse effects to visual resources may occur from prolonged watering restrictions.

7.4.2 Proposed Action

Gross Reservoir

As described in Section 3.15 of the Moffat Project FEIS, past Denver Water visitor surveys indicate that Gross Reservoir's most desirable attributes are its feeling of remoteness, the general lack of man-made structures and/or human intervention, other scenery-related attributes, and the opportunity for scenery-related activities such as sightseeing and wildlife viewing. Due to the recreational nature of use and the scenic amenities valued by residents, user sensitivity to visual change is considered to be high.

Temporary construction activities would create major adverse temporary direct impacts to visual resources at Gross Reservoir. Activities include quarries and borrow areas, construction staging and parking areas, a temporary concrete production plant, heavy machinery traffic, blasting, dam construction, stockpile and spoil areas, vegetation removal, temporary and permanent road construction, and associated temporary haul roads, all of which would exhibit dust and bare soils to viewers. These activities would be incompatible with the recreational and scenic nature of the area, and would be a major short-term impact.

Long-term direct impacts to visual resources at Gross Reservoir would include changes in scale to the shoreline, reservoir elevation, and dam profile; permanent inundation of scenic areas; relocation

of existing facilities and a new road network in currently undisturbed areas; disturbed areas undergoing restoration; and a new auxiliary spillway. The primary differences between the existing landscape character and the proposed action would be the scale of the reservoir body, an elongated shoreline, a wider dam crest, and new visual relationships of the reservoir to topographical features. The unattractive visual contrast created by reservoir fluctuations would be similar to the Current Conditions. Popular viewpoints from eight of the nine designated recreation areas would be inundated, but new views with potentially high scenic quality could be created. Portions of Forsythe Canyon and South Boulder Creek Inlet, which have very high scenic quality, would be directly affected by inundation, as would the Peninsula Recreation Area, which has been moderately impacted by human uses and erosion. Lands above the proposed normal water level with high scenic quality would not be impacted, although they would be perceived differently from new viewpoints and within a new context. The upper portion of the quarry site would remain visible above the enlarged reservoir's water surface and would be a major permanent impact due to the degree of change in landscape character. The dam axis, arch radius, crest width, materials, and downstream slope, would remain similar to the existing visual conditions, but at a larger scale. The dam has been in use for over 50 years and in that time has become an acceptable architectural element of the landscape character; thus the dam raise itself would result in a minor visual impact.

Scenery guidelines in the Denver Water Article 414: Gross Reservoir Visual Resource Protection Plan and USFS ARNF's Forest Plan require that "the overall landscape character around the reservoir should remain natural appearing with limited human intervention" (Denver Water 1999), and that the valued landscape character appear intact. The scenic integrity objectives for the USFS land that would be disturbed by the quarry state that "Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such a scale that they are not evident" (USDA 1995). It is not possible to completely mitigate the major short-term direct construction impacts in order to meet these objectives.

Long-term impacts would only partially meet the desired future condition. The new shoreline and recreational use areas would retain the existing, valued landscape character. The new water elevation, reservoir size, and dam would not be "at such a scale that they are not evident" in the short term, but would become less evident in the long term as viewers became accustomed to the new reservoir size. The quarry, if effectively reclaimed, would "repeat the form, line, color, texture, and pattern common to the landscape character…[in such a way] that they are not evident." The auxiliary spillway, however, would not be compliant with management guidelines and would be considered a major adverse long-term impact.

River Segments

The Moffat Project would have a varying level of effect on stream flows, diminishing flows at some locations and increasing flows at other locations and at different times of the year. In general, the Moffat Project would have only a minor effect on flow levels during periods of low flows, when streams are most sensitive to visual change. Most of the flow changes would occur during periods of naturally higher flows (May, June, and July). The resulting flows would still be within the range of natural variability, both seasonally and from year to year, that is acceptable to and expected by most viewers, as described in Section 3.17.5 of the Moffat FEIS. The visual experience in mountain communities often contributes to a diverse recreation experience, and to some extent, helps to characterize surrounding land uses. Given the high amount of visitation in some mountain communities for recreation, tourism and as retirement and vacation destinations, flow reductions in certain times of year may have minor, indirect effects to overall experience for visitors and residents. Exceptions to these general statements are addressed in more detail in the following

sections, considering Full Use of the Existing System and Full Use with a Project Alternative (2032).

Colorado River

When comparing Full Use of the Existing System to the Proposed Action, all flow depletions (all months of all years) would be below the level of perceptible change. For example, at Hot Sulphur Springs, average flows in May would drop by less than 5% and by less than 1% at Kremmling. Flows during periods of low flow (i.e., fall to winter), would show little or no change. As such, there would be no impacts to visual resources or aesthetics on this river segment resulting from the Proposed Action compared to Full Use of the Existing System.

Fraser River

When comparing Full Use of the Existing System to the Proposed Action, flow changes on the Fraser River would result in visual or aesthetic impacts in May, June, and July of an average year. The intensity of the impact would be greatest near the Winter Park gage and would diminish downstream towards the Granby gage. Exact percentages vary, but flow reductions near the Winter Park gage would be about as much as 43% in June in average years under the Proposed Action compared to Full Use of the Existing System. These reductions in average monthly flows would be detectable and even apparent to many observers. However, as noted in studies cited at the beginning of this section, flow reductions during periods of high flow may not be perceived as adverse.

Downstream of Crooked Creek, impacts would be further reduced and would be detectable only to skilled observers. For example, flows in June below Crooked Creek would drop from 476.3 cfs under Full Use to 387.6 with the Proposed Action, a reduction of 19%. At locations higher in the basin, little or no reduction in flows would occur during periods of low flow (i.e., during the fall and winter months).

As no additional diversions are planned in dry years under the Proposed Action compared to Full Use of the Existing System, it is not anticipated that there would be any flow changes at this time when the river would be most vulnerable to visual change. For example, in the low flow period August through December, flows near Winter Park would be almost identical for Full Use and the Proposed Action, with a slightly higher reduction occurring in January when flows would drop from 4.0 cfs under Full Use to 3.9 cfs with the Proposed Action. A similar pattern would result at locations further downstream.

Williams Fork River

Flow changes between Current Conditions (2006) and the Proposed Action would exhibit a similar pattern to that described on the Fraser River. In the upper basin, the greatest absolute flow changes would occur in June and July. For example, average flows in June under Project implementation would drop from 87.3 cfs at Full Use to 69.3 cfs near the Steelman Creek gage, a reduction of approximately 21%. The reduction from Full Use above the Darling gage would be from 162.8 to 144.9 cfs, or 11%. Overall, when comparing Full Use of the Existing System to the Proposed Action at most locations, flow changes associated with Project implementation would be minor and largely limited to periods of high flows when changes are less perceptible and not likely to be noticed by most observers. Flow reductions during periods of low flow would be minimal at all locations on the Williams Fork; however, any reductions in flows during these periods would be considered adverse. When comparing Full Use of the Existing System to the Proposed Action, no flow changes would occur above William Fork Reservoir during dry years. The only flow decrease in dry years would be a flow reduction of 1% in July below Williams Fork Reservoir under the Proposed Action.

Blue River

Blue River flows are highly variable between seasons and years because of the dam releases from Dillon and Green Mountain reservoirs. When comparing Full Use of the Existing System to the Proposed Action, flow changes (including depletions and increases) as a result of the Proposed Action would be imperceptible in all months of all years, except in October of wet years above Green Mountain Reservoir (15%) below the confluence with Boulder Creek. This change would be within the range of normal variability and would also be consistent with changes as a result of frequent dam releases and the seasonal drop-off in flows (i.e., transition into winter low flows). As such, impacts to visual resources on the Blue River above Green Mountain Reservoir would be negligible. Below Green Mountain Reservoir, the flow changes would be below the level of perceptible impacts.

South Boulder Creek

South Boulder Creek would serve as the conduit for increased West Slope diversions under Full Use of the Existing System. When comparing Full Use of the Existing System to the Proposed Action above Gross Reservoir, minor flow increases in South Boulder Creek would be imperceptible to casual observers with the exception of June, when flow increases would be 106 cfs (17%) and 153 cfs (32%) in average and wet years. Overall, visual impacts to South Boulder Creek above Gross Reservoir would be minor and beneficial.

When comparing Full Use of the Existing System to the Proposed Action, reservoir outflow changes would be significantly higher in winter months (i.e., low flow periods) of all years immediately below Gross Reservoir. Average year flows are projected to increase by as much as 865% from 10 cfs to 88 cfs below the dam in January. These additions, while high in the winter, are characteristic of early spring flows and though perceptible would not create an adverse effect.

When comparing Full Use of the Existing System to the Proposed Action, no perceptible impacts to stream appearance or other visual resources would result downstream (near Eldorado Springs gage).

North Fork South Platte River

When comparing Full Use of the Existing System to the Proposed Action, summer flows would increase, resulting in an additional 13 to 29% during the summer months from May through August below the Geneva Creek gage. A decrease of winter flows of as much as 30% would also occur from November through March. These decreases would result in adverse minor to moderate impacts to visual resources.

South Platte River

When comparing Full Use of the Existing System to the Proposed Action, flow changes on the South Platte River, with the exception of immediately below Chatfield Reservoir, would be imperceptible to the casual observer, in which case no additional impacts are expect to occur to visual resources. Under the Proposed Action, flows on the South Platte River below Chatfield Reservoir (but above Denver gage) would increase by approximately 25% during the months of December and January in average years, about 30% during the months of January and April in dry years, and 27% in December of wet years, resulting in a minor beneficial effect on aesthetic quality along this reach. Flow depletions in all other months of all years would be imperceptible to casual observers.

7.4.3 Alternative 1c

Gross Reservoir

The slightly smaller surface size and lower dam height of Gross Reservoir under this alternative would not substantially change from the visual impacts described under the Proposed Action. However, the area permanently disturbed for the quarry would be the most visible under Alternative 1c compared to the other action alternatives due to the smaller inundation area.

Leyden Gulch Reservoir Site

The existing scenic quality of the Leyden Gulch site is low due to the uniform vegetation. However, when experienced in context with the varied topography around Leyden Creek, the steep uplift of the Laramie Formation hogback to the east, and panoramic views of the Front Range mountain backdrop to the west, the overall landscape has a high degree of scenic interest. The reservoir site is highly visible. User sensitivity to visual change is high due to the high number of daily travelers and ongoing efforts by local governments and citizen groups to preserve foreground views of the Front Range Mountain Backdrop.

Temporary construction activities would create short-term direct impacts to visual resources. These activities would be highly visible to travelers along SH 93 and SH 72, from residences, and to passive recreational users of adjacent open space. These activities would create a high degree of contrast (or incompatibility) with the recreational and scenic nature of the area, and are considered a major short-term impact.

A new dam would lie in the immediate foreground adjacent to and above travelers on SH 93, and with contrasting lines, textures and scale compared to the existing conditions. The crest of the dam would rise approximately 200 feet above SH 93, creating a tunnel impact and obstructing existing views of the Front Range to viewers for a distance of over 4,000 feet. The relocated section of SH 93 would lie 400 feet to the east of its existing alignment, within 150 horizontal feet of the north-south rock faces, with cut slopes and a disturbance area within 50 feet of the steep Laramie Formation walls. The revegetated downstream face of the earthfill dam would be highly visible and appear as a grass-covered, engineered slope.

The reservoir body, while a new feature to Leyden Gulch, would appear compatible with and potentially be an improvement to the open, rangeland character of the region which already consists of a scattering of open water storage facilities and water bodies visible from SH 93. Weak and moderate visual contrasts would be created by the new access roads, site fencing, service lighting, above ground wood-post transmission line, and ongoing restoration of three staging areas. In summary, a new reservoir at Leyden Gulch would result in a high degree of permanent contrast from the existing scenic attributes, and a loss of important views to scenic areas from some viewpoints.

Boulder County and Jefferson County open space programs have acquired properties to the immediate north and south as part of the Front Range Mountain Backdrop/Foreground Preservation Project to ensure that the foothills, hogbacks, and other key Front Range visual areas are protected. Construction of a reservoir and dam at Leyden Gulch would result in a marked change in visual environment by obstructing views, converting a natural-appearing setting to a more developed condition, and potentially degrading scenic features. Therefore, it would not be compliant with existing management and policy guidance, and would be considered a long-term impact.

River Segments

Impacts to river segments would be similar to those described for the Proposed Action.

7.4.4 Alternative 8a

Gross Reservoir

The slightly smaller surface size and lower dam height of Gross Reservoir under this alternative would not substantially change the visual impacts described under the Proposed Action.

South Platte River Facilities

Utilizing available storage capacity in previously constructed gravel pits would improve the scenic quality and aesthetics of the study area. This would result in minor, beneficial long-term visual improvements.

Four acres adjacent to the Worthing Pit would be converted to an AWTP, consisting of several buildings and structures no more than two stories in height (25-30 feet). Building architecture would be designed to be consistent with the surrounding area. Visual contrast resulting from the new facilities would be negligible as residential and gravel processing buildings of similar scale and architecture currently exist within the study area.

The dechlorination facility would be an unlit concrete structure would be visible along SH 72 east of the Leyden Gulch Reservoir site, a regional transportation corridor that is rapidly urbanizing. Short-term visual contrast would result during construction; however, there would be no long-term effect as the facility is of comparable size and scale with nearby buildings.

The existing lakes in the unincorporated Project vicinity, including those within the Adams County Regional Park, were all created through gravel mining activities. Water storage activities (including river diversions) are allowable uses in the Adams County development regulations for the Project area. The Adams County Regional Park Master Plan acknowledges the short term construction impacts relating to gravel mining and water storage operations and anticipates their future positive contributions to the scenic and recreational character of the area in 10 to 20 years. Therefore, while construction of the South Platte River Diversion and advanced water treatment would create short-term contrasts to the existing visual resources, the Project does not conflict with the scenic management guidelines for the area.

Conduit O

Long-term visual impacts at Conduit O would be minor and mostly temporary.

River Segments

Impacts to river segments would be similar to those described for the Proposed Action.

7.4.5 Alternative 10a

Gross Reservoir

The slightly smaller surface size and lower dam height of Gross Reservoir under this alternative would not substantially change from the visual impacts described under the Proposed Action.

Denver Basin Aquifer Facilities

Adverse impacts from the visual contrast created by well clusters would vary based on their placement within each park as well as the size and type of park. Generally, the smaller parks and special interest locations (such as sculpture parks or memory gardens) would experience adverse impacts to visual character. Larger parks that offer a variety of built amenities or a diversity of

topography and vegetation for screening would experience only minor impacts. Construction of the pipelines and temporary staging areas would cause temporary visual impacts due to the construction activity and the soil disturbance. No visual contrast would result from the new AWTP because industrial buildings of similar scale and architecture currently exist within the Project area.

Conduit M

Long-term visual impacts for Conduit M would be minor and mostly temporary.

River Segments

Impacts to river segments would be similar to those described for the Proposed Action.

7.4.6 Alternative 13a

Gross Reservoir

The slightly smaller surface size and lower dam height of Gross Reservoir under this alternative would not substantially change the visual impacts described under the Proposed Action.

South Platte River Facilities

Impacts to South Platte River Facilities would be the same as described for Alternative 8a.

Conduit O

Long term visual impacts at Conduit O would be temporary and minor.

River Segments

Impacts to river segments would be similar to those described for the Proposed Action.

8. EVALUATION AND TESTING

Dredge and fill materials would be used to expand the Gross Reservoir dam. Dredge and fill materials would be obtained from areas within the Project site or transported to the site by trucks, and would include soil, gravel, and rock. No hazardous material would be used as fill material in waters or wetlands. Cement and fly ash would be used and would be brought to the site from nearby areas.

9. (SUBPART H) ACTIONS TO MINIMIZE ADVERSE EFFECTS AND PRACTICABLE STEPS TO MINIMIZE POTENTIAL ADVERSE IMPACTS

Denver Water would avoid, minimize, and provide compensatory mitigation for the effects of any alternative constructed. Avoidance and minimization techniques are discussed in Section 3.1.7 of this Section 404(b)(1) analysis, and mitigation strategies are discussed in Appendix M of the Moffat Project FEIS.

9.1 DIRECT IMPACTS TO WETLANDS

Compensatory mitigation for all direct impacts to wetlands will follow the Corps and EPA compensatory mitigation rule (73 *Federal Register* 19594 [April 10, 2008]). The compensatory mitigation rule favors the use of approved wetland mitigation bank credits when available. For all of the action alternatives, Denver Water would purchase approved wetland mitigation bank credits

when available to compensate for lost wetlands associated with the discharge of fill material. If approved wetland mitigation bank credits are not available, Denver Water would develop and implement permittee-responsible compensatory mitigation.

9.2 IMPACTS TO AQUATIC RESOURCES

In its FWMP, Denver Water committed to the following mitigation measures:

- Establish a viable Colorado River cutthroat trout fishery in a suitable location in Grand County
- Colorado River, Fraser River, and Ranch Creek water temperature monitoring
- Aquatic habitat improvements in the North Fork South Platte River, and Fraser River and tributaries
- Additional environmental storage in Gross Reservoir to store water for enhancement flows for South Boulder Creek downstream of Gross Reservoir (Environmental Pool)

9.3 IMPACTS TO RECREATION FACILITIES AT GROSS RESERVOIR

Denver Water has committed to providing comparable recreation facilities that would replace the facilities that would be inundated by an expanded Gross Reservoir.

9.4 IMPACTS TO FEDERALLY LISTED SPECIES

All of the action alternatives would affect Colorado River flows and South Platte River flows that, in turn, would affect Federally listed fish species in the Colorado River and a variety of Federally listed species (the target species) using the central and lower Platte River and its associated habitat in Nebraska.

Denver Water signed a recovery agreement with the USFWS in 2000. The actions taken under the Recovery Implementation Program for Endangered Fish Species in the upper Colorado River Basin would cover reduced flows in the Colorado River associated with any of the action alternatives.

Denver Water is a member of SPWRAP, which assists in implementing the State of Colorado's obligation to benefit the Platte River target species and the PRRIP. Changes in flows of the South Platte River associated with the action alternatives would be covered by Denver Water's participation in SPWRAP.

The USFWS issued its Final BO on December 6, 2013. Refer to Appendix G of the Moffat Project FEIS.

9.5 ACTIONS CONCERNING THE LOCATION OF DISCHARGE

An extensive alternatives analysis was conducted. Following the coarse screen, five alternatives, plus a No Action Alternative underwent a more thorough environmental analysis to determine the LEDPA. The location of discharge was dependent on the alternatives analysis to identify the LEDPA.

9.6 ACTIONS CONTROLLING THE MATERIAL TO BE DISCHARGED, THE MATERIAL AFTER DISCHARGE, AND THE METHOD OF DISPERSION AND RELATED TECHNOLOGY (230.64, 230.71, 230.72, AND 230.73)

No material that contains hazardous materials would be discharged into waters of the U.S. BMPs would be used to control the material after discharge. Temporary and permanent erosion-control devices would be used during construction of reservoir, road, pipeline, and attendant features; and during canal reconstruction to control discharges and methods of discharges into waters of the U.S. Denver Water would implement a construction SWMP.

9.7 ACTIONS AFFECTING PLANT AND ANIMAL POPULATIONS (230.75)

BMPs would be followed during all phases of Project construction. Temporary and permanent erosion control would take place, and would include efforts such as sediment control and revegetation. Weed control and weed management would also take place during all phases of construction.

Preconstruction clearances would be performed to limit impacts to migratory birds in areas of potential habitat for these species, and construction would be timed so that active nests are not affected.

Refer also to the FWMP in Appendix M of the Moffat Project FEIS.

9.8 ACTIONS AFFECTING HUMAN USE (230.76)

Expansion of the Gross Reservoir dam would take place so that disruptions to traffic are minimized to the greatest extent practicable.

9.9 OTHER ACTIONS (230.77)

Mitigation for impacts to wetlands, vegetation, and other resources would take place as described in the Moffat Project FEIS.

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